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FEDERAL HIGHWAY ADMINISTRATION

COMPLETED

PROCESS REVIEW/EVALUATION SEMINAR

U. S. DEPARTMENT OF TRANSPORTATION

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DESCRIPTION OF PROCESS REVIEW/EVALUATION

- PROCESS REVIEW/EVALUATION, PROGRAM REVIEW/EVALUATION AND PROCESS REVIEW/PRODUCT EVALUATION ARE DIFFERENT TITLES USED FOR DESCRIBING THE PROCESS REVIEW CONCEPT.
  - ALL ARE ESSENTIALLY THE SAME.
  - FOR SIMPLICITY THE CONCEPT WILL BE REFERRED TO AS "PR&E"

- PR&E IS A COMPREHENSIVE MANAGEMENT PROGRAM FOR REVIEWING AND EVALUATING STATE/LOCAL AGENCY POLICIES, PROCEDURES, PRACTICES AND CONTROLS FOR THE DEVELOPMENT OF FEDERAL-AID PROJECTS.

- IN GENERAL, PR&E REPLACES THE DETAILED PROJECT-BY-PROJECT REVIEW PROCEDURES TRADITIONALLY FOLLOWED BY FHWA.

- IT PROVIDES FOR INSPECTION OF PRODUCTS ON A SAMPLING BASIS TO ENSURE QUALITY AND ECONOMY.
  - SAMPLING OF PRODUCTS MAY BE USED EITHER TO:
    - IDENTIFY PROBLEM AREAS FOR DETAILED REVIEW, OR
    - TO TEST CONCLUSIONS MADE REGARDING THE ADEQUACY OF THE PROCESSES, PROCEDURES, CONTROLS, ECT.

MAJOR PHASES OF A REVIEW

- PRELIMINARY PLANNING - (PROBLEM DEFINITION)
- PRELIMINARY ANALYSIS - (RECONNAISSANCE)
- DATA AND INFORMATION COLLECTION
- ANALYSIS
- DOCUMENTATION (REPORT PREPARATION)
- IMPLEMENTATION AND FOLLOW-UP

ITEMS TO BE CONSIDERED
DURING THE PRELIMINARY PLANNING PHASE

- **DEFINE PROBLEM OR PURPOSE**

  - GENERALLY DEFINED AS ONE OF REVIEW AREAS.

- **DEFINE SCOPE**

  - AREA COVERED BY REVIEW AND DEPTH OF IMFORMATION AND ANALYSIS REQUIRED.

- **DEFINE OBJECTIVES**

  - WHAT YOU, YOUR D.A., AND FHWA WANT. (IDEAL SITUATION)

- **DEFINE ASSUMPTIONS**

  - FACTORS THAT MUST BE ESTIMATED.

- **DEFINE CONSTRAINTS**

  - LIMITING FACTORS ON REVIEW EFFORT. (BUDGET, PERSONNELL, TIME, ACCEPTABILITY OF REVIEW APPROACH TO SHA, ETC.)

(CONTINUED)

- **Define Criteria**

  - MEASURES OF EFFECTIVENESS AND COMPLIANCE.

- **Define Resources**

  - REVIEW TEAM COMPOSITION, TRAVEL REQUIREMENTS, OTHER SUPPORT.

- **Estimate Completion Date of Review**

PRELIMINARY PLANNING ACTIVITIES

- REVIEW LEADER -

  DEVELOPS PRELIMINARY PLAN

- REVIEW TEAM -

  HOLDS DISCUSSIONS WITH SUPERVISORY OFFICIALS:

  - DIVISION
  - SHA/LOCAL AGENCY

- REVIEW TEAM -

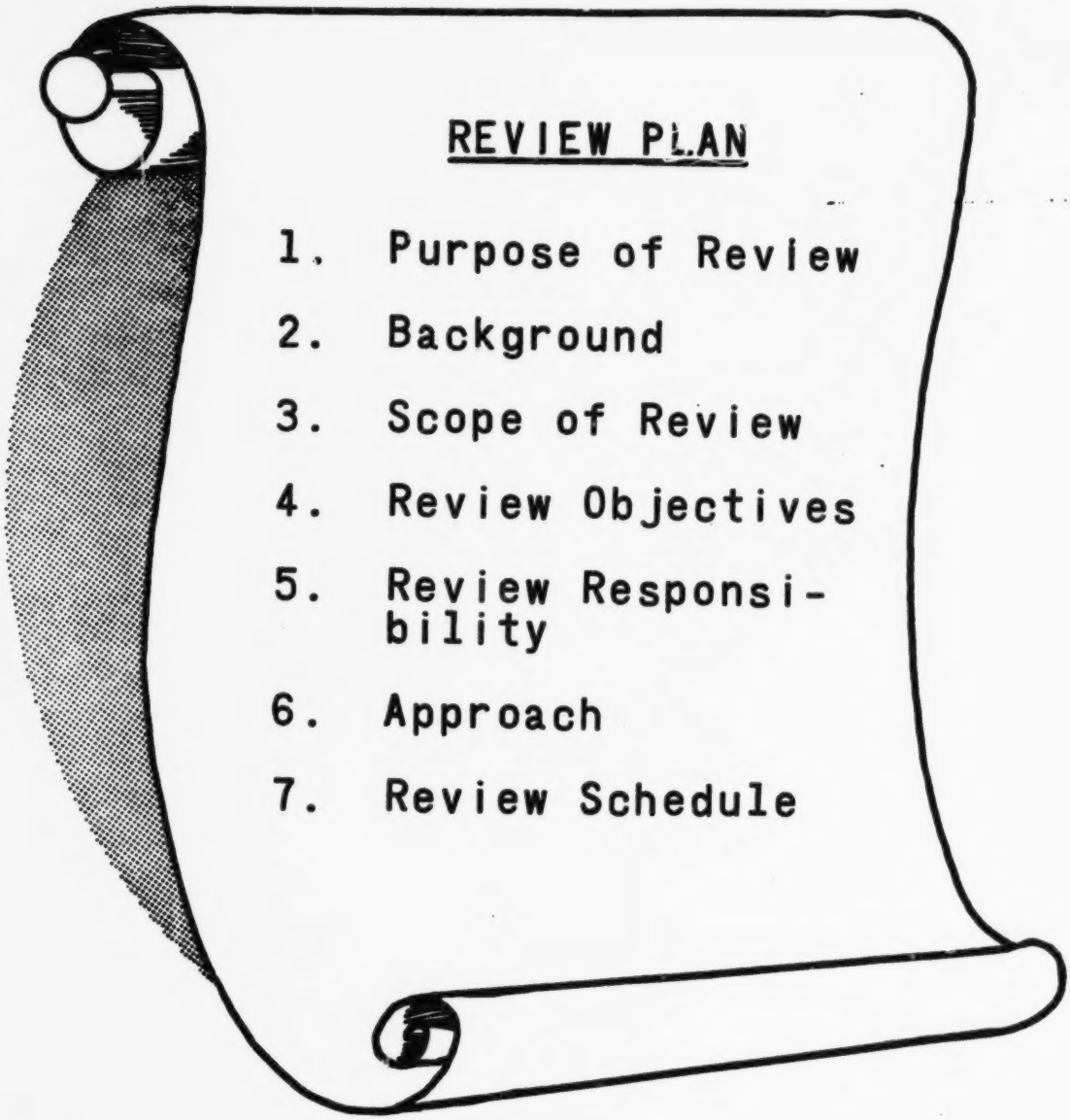
  HOLDS DISCUSSIONS WITH OTHER KNOWLEGABLE PEOPLE:

  - OTHER DIVISION FUNCTION STAFF
  - REGIONAL STAFF

- REVIEW TEAM -

  DEVELOPS FINAL REVIEW PLAN

REVIEW PLANS serve as the CHARTER



ITEMS INCLUDED IN A REVIEW PLAN

- **PURPOSE** - TO ANNOUNCE THE REVIEW AND BRIEFLY DESCRIBE THE AREA TO BE REVIEWED.

- **BACKGROUND** - A HISTORY OF THE EVENTS LEADING TO INITIATION OF THE REVIEW.

- **SCOPE** - DEFINES THE AREA AND ORGANIZATIONAL ELEMENT COVERED BY THE REVIEW.

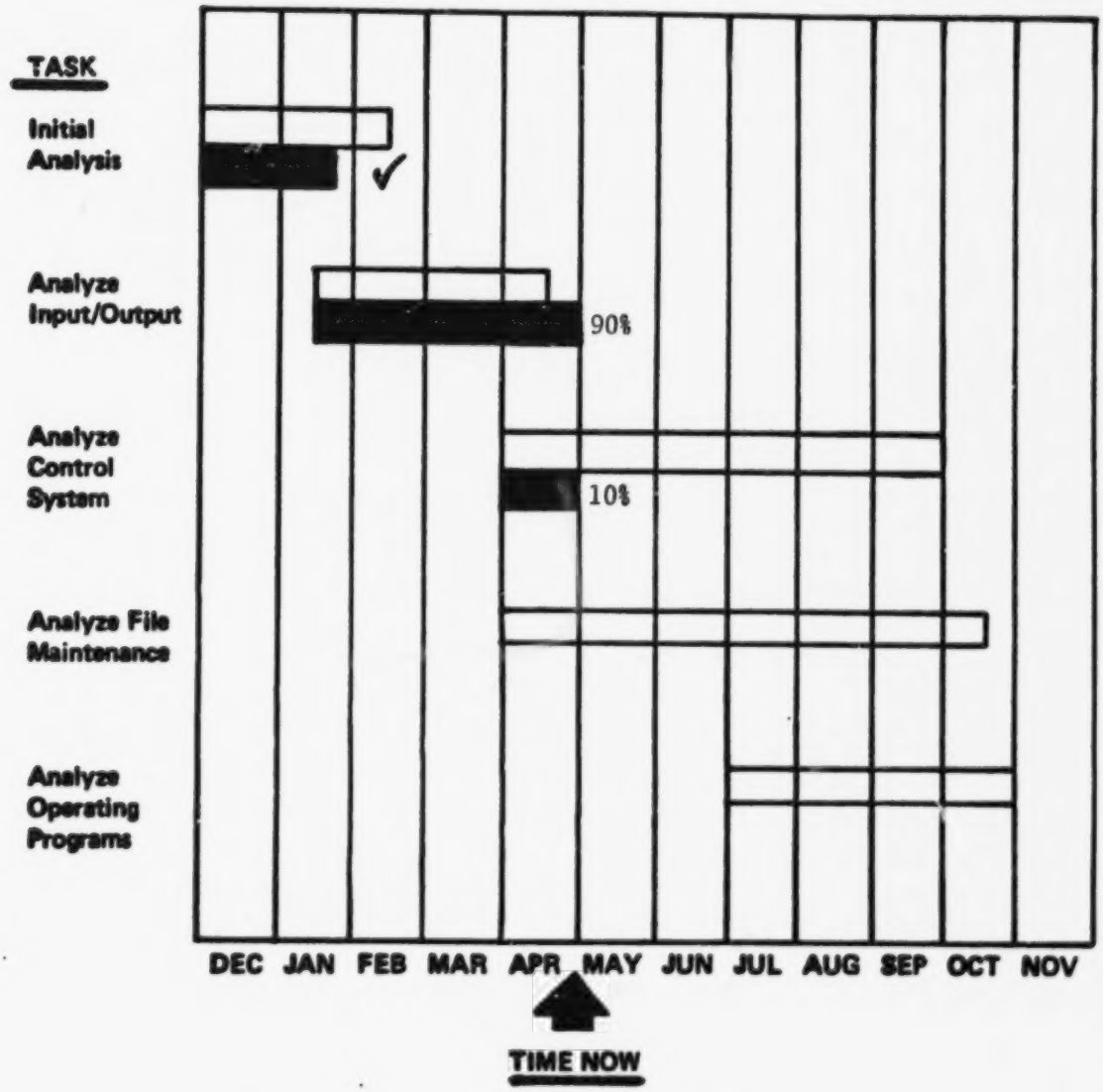
- **OBJECTIVES** - SPECIFIC AIMS OF THE STUDY.
  - DESIRED ACCOMPLISHMENTS

- **REVIEW RESPONSIBILITIES** - DESIGNATES THOSE RESPONSIBLE FOR THE CONDUCT OF THE REVIEW (TEAM COMPOSITION), AS WELL AS SPECIAL SUPPORT ACTIVITIES REQUIRED OF OTHER OFFICES OR PERSONNEL.

- **APPROACH** - DESCRIBES THE SEQUENCE OF MAJOR ACTIVITIES TO BE UNDERTAKEN AND METHODOLOGIES TO BE EMPLOYED DURING PLANNED PHASES OF THE REVIEW (FROM PRELIMINARY ANALYSIS THROUGH REPORT PREPARATION).

- **REVIEW SCHEDULE OR COMPLETION DATE** - THE TIME TABLE FOR THE CONDUCT OF THE PHASES OF THE REVIEW AND/OR THE EXPECTED COMPLETION DATE OF THE REVIEW REPORT.

SIMPLIFIED GANTT CHART



A simplified Gantt Chart, illustrated above, is a useful tool both for study planning (scheduling) and for monitoring and controlling study progress.

WORK PLAN FOR DESIGN AND DEVELOPMENT OF AN FHWA MANAGEMENT INFORMATION SYSTEM

(TASK I)

PRELIMINARY ANAYLSIS

A. INVENTORY

B. DOCUMENTATION

C. INPUT/OUTPUT MATRIX

D. DATA ELEMENT MATRIX

E. FLOW DIAGRAM

F. DATA COLLECTION FORMS

MONTH 1

(TASK II)

DATA COLLECTION

A. WASHINGTON OFFICE

B. FIELD

MONTH 2

(TASK III)

PRESENT SYSTEMS CAPABILITIES

A. MANUAL SYSTEMS

B. AUTOMATED SYSTEMS

C. ACCOUNTING MACHINE SYSTEMS (MCS ETC.)

MONTH 3

(TASK IV)

DATA ANALYSIS

A. IDENTIFY DATA REQUIREMENTS

B. UPDATE FLOW DIAGRAM

C. DETERMINE ALTERNATIVES

MONTH 4

(TASK V)

COST BENEFIT ANALYSIS

A. DETERMINE:

(1) COST OF ALTERNATIVES

(2) BENEFITS OF ALTERNATIVES

(3) ACCEPTABILITY AND IMPACT OF ALTERNATIVES

(4) APPROPRIATE RECOMMENDATIONS

MONTH 5

(TASK VI)

DEVELOP FUNCTIONAL SYSTEMS SPECIFICATIONS

A. FUNCTIONAL SYSTEM DESCRIPTION AND DESIGN

B. DATA REQUIREMENTS DESCRIPTION

MONTH 6

(TASK VII)

APPROVAL AND IMPLEMENTATION

A. FINAL SYSTEMS APPROVAL

B. IMPLEMENTATION

C. POST IMPLEMENTATION AUDIT

IMPLEMENTATION SCHEDULE TO BE DETERMINED

AN ALTERNATE METHOD OF PRESENTING THE STUDY SCHEDULE IS ILLUSTRATED ABOVE.

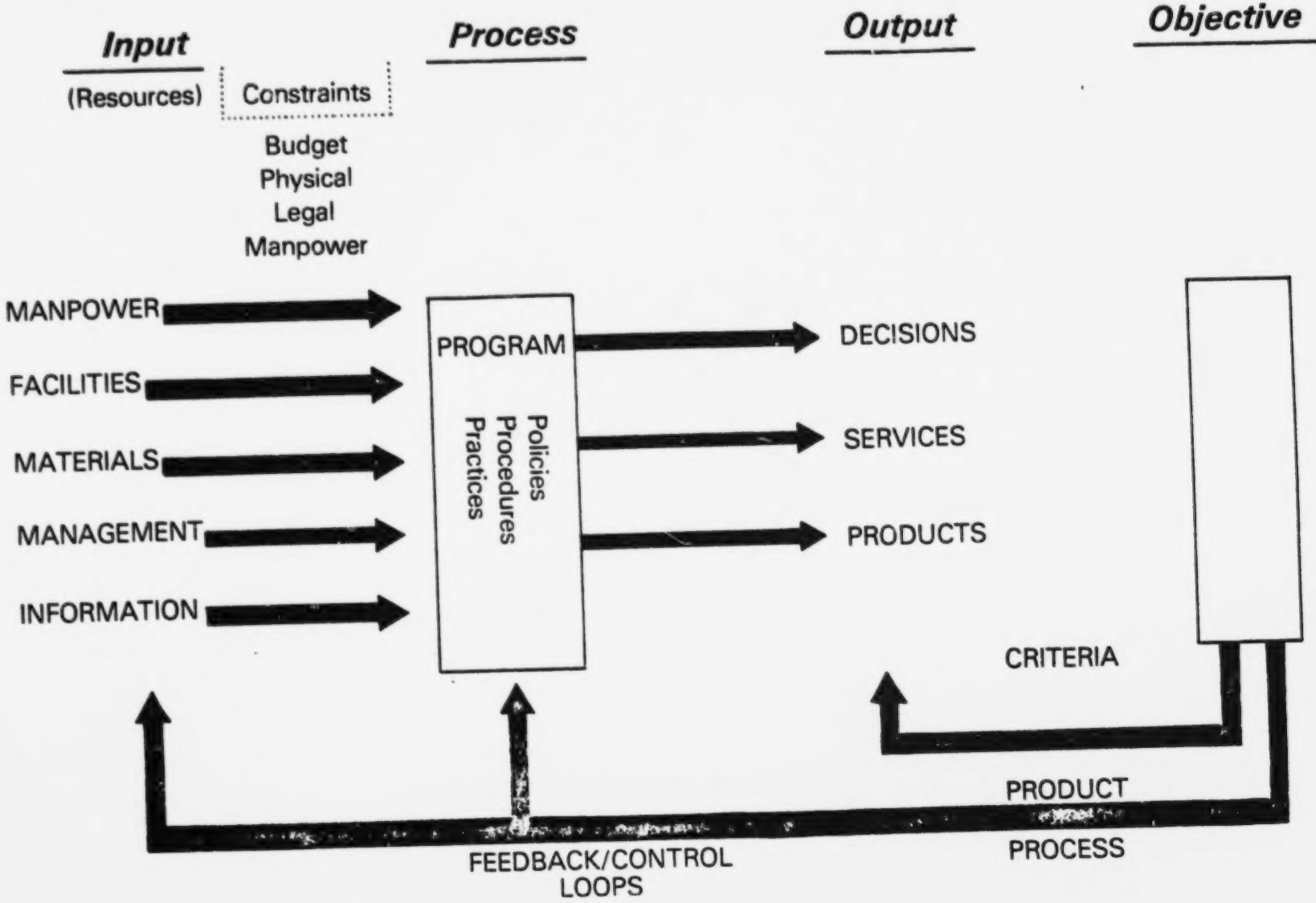
PROCESS REVIEW/EVALUATION OBJECTIVES

- There are two general categories of Process Review Objectives:
  - Control
  - Process improvement

- **CONTROL**
  - To provide required assurances that SHA/local agencies perform within the framework of:
    - Applicable Federal & State laws
    - FHWA regulations & policies
    - SHA/local agency policies procedures
    - Acceptable professional (engineering, planning, ROW, ect.)
  - To provide assurance that resultant products are of an acceptable quality

- **PROCESS IMPROVEMENT**
  - To identify weaknesses, deficient processes or areas requiring improvement
  - To provide advice and recommendations to correct or improve deficiencies
  - To identify innovative or unusually effective features of operation for possible application in other areas
  - To furnish information concerning the need for changes in FHWA and other requirements

MAJOR ELEMENTS FOR REVIEW



GENERAL CRITERIA

SOME EXAMPLES OF CRITERIA ARE:

(A) WRITTEN REQUIREMENTS (LAWS, REGULATIONS, INSTRUCTIONS, MANUALS, DIRECTIVES, CONTRACT SPECIFICATIONS, ETC.);

(B) INDEPENDENT OPINION OF EXPERTS OUTSIDE THE ORGANIZATION (AASHTO STANDARDS, AUDIT REPORTS);

(C) PRUDENT BUSINESS PRACTICE;

(D) MANAGERIAL/TECHNICAL EXPERTISE (EDUCATIONAL, EXPERIENCE OR TRAINING REQUIREMENTS);

(E) VERBAL INSTRUCTIONS;

(F) UNWRITTEN OVERALL OBJECTIVES AS EXPLAINED BY MANAGEMENT OFFICIALS; AND

(G) COMMON SENSE.

KEY CONSTRUCTION ELEMENTS AND QUALITY FACTORS

ELEMENT	GROUP I	GROUP II	GROUP III	
Rigid Pavement	-W/C ratio -Consolidation/density -Joint Construction	-Air content -Thickness -Finish/texture/skid resistance -Strength -Vibration/placement -Curing	-Surface smoothness to tolerance -Slump/plasticity -Uniformity of mix -Gradation -Rebar placement/cover -Aggregate quality	-Cement quality -Total time cement exposed to moisture -Mix effort -Batching/mixing inspectio -Mix temperature
Bituminous Pavement	-Compaction/density -Asphalt content -Gradation	-Surface smoothness/tolerance -Thickness -Asphalt source, grade and properties -Aggregate quality -Stability -Void ratio -Skid resistance	-Uniformity of mix -Mix temperature -Viscosity -Ductility -Plasticity -Batching/mixing inspection	-Longitudinal joint constr -Use of admixtures -Bond with underlying laye -Laydown inspection
Bridge Deck and/or Protective System Construction	-Consolidation/density -Rebar placement/ concrete cover -W/C ratio -Density (Iowa Mix)	-Mix temperature -Curing -Air content -Strength -Finish/texture/skid resistance -Vibration/placement -Formwork	-Surface smoothness/tolerance -Thickness -Slump/plasticity -Gradation -Cement quality -Batching/mixing inspection -Falsework	-Transporting/discharging -Total time cement exposed to moisture -Aggregate quality -Mixing effort -Mix uniformity -Use of admixtures
Structural Concrete	-Consolidation/density -W/C ratio	-Curing -Strength -Air content -Rebar placement/cover -Vibration/placement -Formwork -Temperature Control	-Slump/plasticity -Use of admixtures -Finish -Cement quality -Aggregate quality -Gradation	-Total time cement exposed -Mixing effort -Batching/mixing inspectio -Transporting/discharging concrete
Base Course	-Compaction/density -Gradation	-Thickness -Moisture/admixture content -Aggregate quality -Uniformity of materials -Drainage	-Surface smoothness/tolerance -Use of admixtures -Treatment/admixtures -Placement inspection -Strength of treated bases	
Embank[illegible] Fillent	-Compaction/density Moisture/admixture content	-Material quality -Uniformity of ma -Drainage	-Stability -Fine grade line -Placement inspection -Gradation -Soil classification	-Plasticity -Foundation [illegible]paration -Slope rou[illegible] shaping -Equipment [illegible] -Treatment/admixture type

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CRITERIA QUESTIONS

- Do they Really Measure the Area in a Meaningful Way?
- Are there Better Measures/Standards Available?
- Are they Quantifiable or Specific?
- Will they Provide Assurances Called for in Objectives?
- Are they Realistic? (can these measures be made or necessary data collected given reasonable time, money & resources)
- Do you Need to Revise Objectives & Approach Sections?

- **Purpose of Preliminary Analysis Phase**

  - EDUCATION OF REVIEW TEAM
  - IDENTIFICATION OF EXISTING DATA
  - IDENTIFICATION OF DATA TO BE COLLECTED
  - DEVELOPMENT OF CHECKLISTS

PRELIMINARY ANALYSIS (RECONNAISSANCE)

A. Review Each of the Following:
   - — Mission and Functions
   - — Organization and Staffing
   - — Delegations of Authority
   - — Workload (Trends, Numbers of Projects, Size/Complexity/Type of Projects)
   - — Previous Reviews, Audits, Etc.
   - — Policy, Procedure Manuals, Technical Manuals
   - — Lay-Out and Flow of Work
   - — Specifications and Plans

B. Develop Data Collection Checklists and Instruments.

C. Briefing and Orientation Session.

PRELIMINARY ANALYSIS

MISSION & FUNCTIONS

TRYING TO DETERMINE WHY THE UNIT EXISTS, WHAT IS IS SUPPOSED TO CONTRIBUTE TO THE LARGER ORGANIZATION AND HOW.

ORGANIZATION STRUCTURE

TRYING TO GET A PICTURE OF HOW THE UNIT OFFICIALLY FITS INTO THE TOTAL ORGANIZATION, AS WELL AS IT'S INFERNAL STRUCTURE AND RELATIONSHIPS.

DELEGATIONS OF AUTHORITY

DETERMINING HOW MUCH CONTROL THE UNIT HAS OVER PLANNING AND ACCOMPLISHING IT'S OWN WORK.

INFORMAL ORGANIZATION

WHERE DO EMPLOYEES GO FOR GUIDANCE, FOR INFORMATION?

POLICIES AND PROCEDURES

WHAT ARE THE POLICIES AND PROCEDURES GOVERNING THE ORGANIZATION, FUNCTION OR PROCESS UNDER REVIEW.

FORMS & REPORTS

OBTAIN AN INVENTORY OF FORMS AND REPORTS ALSO FIND OUT WHAT THE REPORTING REQUIREMENTS IN EFFECT FOR MIS, PROGRAM OR PROJECT STATUS.

STAFFING TRENDS

TRYING TO GET A 2 OR 3 HISTORY OF STAFFING PATTERNS HOW MUCH OVERTIME HAS BEEN WORKED?

WORKLOAD TRENDS

LOOKING AT 2 OR 3 YEAR PERIOD TO DETERMINE WORKLOAD PATTERNS & CHARACTERISTICS.

PREVIOUS STUDIES, AUDITS

THEY PROVIDE VALUABLE HISTORICAL AND BACKGROUND INFORMATION IF AN ORGANIZATION HAS BEEN EXPERIENCING PROBLEMS, IT WILL HAVE PREVIOUSLY BEEN REVIEWED. WHILE PAST STUDIES OR AUDITS MAY NOT HAVE THE ANSWER YOU ARE LOOKING FOR, THEY TELL YOU ALOT ABOUT THE ORGANIZATION AND HOW SUCCESSFUL THE UNIT HAS BEEN THE PAST IMPLEMENTING PRIOR RECOMMENDATIONS.

- Why Develop Checklists

  - Divide review effort
  - Organize review effort - prevent duplication
  - Identify data collection instruments and methodology for collecting data
  - Briefing document
  - Control of effort - ensures you covered everything

- Data Collection Instruments

  - Interview guides
  - Inspection guides
  - Data collection forms
  - Questionnaires, etc.

Data Collection Checklist

1. ORGANIZATION AND STAFFING

- Present Organization and functions
- Organizational Relationships
- Present Staffing (By Job Title, Grade, & Organization)
  - Authorized
  - On-Board
  - Permanent
  - Temporary
- Significant Changes In Organization and Staffing (3-4 yrs.)
- Personnel Turnover/Staff Experience Levels
- Historical Overtime Data
  - By Personnel Type
  - By Function

2. WORKLOAD

- Description of Items Which Constitues Workload
- Workload Volume
  - Number of Projects
  - Size/Complexity/Type of Projects
- Workload Fluctuations
  - Historical
  - Seasonal
- Current Workload Status
  - Completed
  - In Process
  - Anticipated

3. SYSTEMS AND PROCEDURES

- Pertinent Regulations/Directives/Internal Instructions
- System Flow Diagrams (By Operation/Workload Item)
- Work Processing Statistics
- Description of Manual or Automated Data Systems

ENTRANCE CONFERENCE

- INTRODUCTION AND ORIENTATION WITH SUPERVISORS, ETC.
  - WHAT REVIEW IS ABOUT - PURPOSE AND SCOPE
  - WHAT YOU HOPE TO ACCOMPLISH
  - INFORMATION YOU NEED
  - IDENTIFYING SPECIFIC UNITS AND PERSONNEL TO BE VISITED
  - SET UP INTERVIEW & TRAVEL SCHEDULE
  - SOLICITING ANY IDEAS OR SPECIAL INTEREST AREAS FROM MANAGEMENT
- DISTRIBUTE QUESTIONNAIRES OR FACTUAL DATA COLLECTION FORMS

NOTE: IMPORTANT - ESTABLISH ATMOSPHERE OF COOPERATION AND RAPPORT

- Data collection is a two-part effort

  1) Verifying data collected previously (Preliminary Analysis)

  2) Collecting additional data needed for review

- Two Rules of Data Collection

  1) Always Plan in Advance

     - Needed facts
     - Who has data
     - Where located
     - In what form needed

  2) Conduct in a Manner that:

     - Stimulates cooperation
     - Minimizes employee fears
     - Is tactful & positive

REMINDER: Nobody Likes to be <u>Reviewed</u> or <u>Audited</u>

EXISTING RECORDS

REVIEW:

- LEGISLATION, HEARINGS, EXECUTIVE ORDERS, DIRECTIVES, ETC.
- MANUALS OF PROCEDURES, INSTRUCTION, TRAINING
- ORGANIZATION MANUALS, CHARTS, DELEGATIONS OF AUTHORITY
- CORRESPONDENCE FILES
- WORK PAPERS AND REPORTS FROM PREVIOUS SURVEYS
- BUDGET ESTIMATES AND JUSTIFICATIONS
- STATISTICS GIVEN IN ADMINISTRATIVE REPORTS
- FORMS USED IN PROCESSING
- ETC.

INTERVIEWS

1. ADVANTAGES

   A. ONLY WAY TO COLLECT UNRECORDED INFORMATION

   B. GOOD WAY TO JUDGE A MANAGER, ORGANIZATION, SITUATION (SUBJECTIVE EVALUATION)

   C. MAY ALLOW THE EMPLOYEE TO GIVE INFORMATION MORE FREELY

2. LIMITATIONS

   A. MAY ANSWER QUESTIONS WITH GUESS RATHER THAN ADMIT IGNORANCE

   B. INTERVIEWER MUST TAKE NOTES - ACCURACY MAY BE QUESTIONED

   C. MAY ANSWER WHAT IS BELIEVED TO BE WANTED BY THE INTERVIEWER

   D. LIKELY TO GET A COLLECTION OF EXCEPTIONS BECAUSE EXCEPTIONS ARE MORE MEMORABLE

3. PRINCIPLES

   A. PROPER PREPARATION (CHECKLIST)

   B. CONDUCTED INFORMALLY

   C. SHOULD BE LIMITED TO INFORMATION GATHERING

   D. BE CERTAIN OF ACCURACY

PREPARATION FOR INTERVIEWS

- DETERMINE TYPE OF INFORMATION DESIRED

- FAMILIARIZE YOURSELF WITH SUBJECT MATTER & JARGON

- PREPARE LIST OF QUESTIONS
  - REMEMBER TRYING TO GET PEOPLE TO OPEN UP
    - EXPLAIN, ELABORATE, GIVE THEIR IDEAS FOR IMPROVEMENTS
  - LIST INCLUDES GENERAL AS WELL AS SPECIFIC QUESTIONS
  - REMEMBER NEED TO VERIFY ACTUAL VS. INTENDED PROCESS

- INCLUDE QUESTIONS WHERE ANSWERS ARE ALREADY KNOWN
  - IF YOU GET THE EXPECTED OR CORRECT ANSWER, NO HARM IS DONE
  - IF YOU GET A VARIATION OR COMPLETELY DIFFERENT ANSWER, IT CAN MEAN:
    - PROCEDURE OR REQUIREMENT ISN'T CLEAR
    - WORD ISN'T GETTING DOWN TO THE OPERATION'S LEVEL
    - PROCEDURE OR REQUIREMENT IS UNNECESSARY OR THOUGHT TO BE UNNECESSARY
    - CONTROLS ARE WEAK

NOTE: ALWAYS ASK QUESTION ON PROBLEM AREAS AND SUGGESTIONS FOR IMPROVEMENTS.

GENERAL (PROCESS RELATED) INTERVIEW QUESTIONS

- PROBLEM AREAS?
- WHAT FUNCTIONS DO YOU FEEL ARE BEING PERFORMED?
- WHAT FUNCTIONS DO YOU FEEL SHOULD BE PERFORMED?
- WHICH FUNCTIONS REQUIRE THE MOST EXPENDITURE OF TIME?
  - HOW MUCH TIME?
  - IS EXPENDITURE REASONABLE? SHOULD IT BE MORE OR LESS?
- DO FUNCTIONS PERFORMED CONTRIBUTE MATERIALLY TO ACCOMPLISHMENT OF MISSION
- WHICH FUNCTIONS DO/DON'T?
  - IS THERE A BALANCE OF EFFORT AMONG THE MAJOR FUNCTIONS RELATIVE TO ACCOMPLISHMENT OF THE MISSION?
- WHERE DOES THIS PERSON'S OR GROUP'S WORK FIT, (AT THE BEGINNING, MIDDLE, OR END OF THE CYCLE)?
- DO EMPLOYEES GENERALLY UNDERSTAND WHAT PRIOR/SUCCEEDING ACTIONS TAKE PLACE RELATIVE TO THE OPERATIONS PERFORMED IN THEIR RESPECTIVE COMPONENTS?
- WHAT PROCEDURES EXIST FOR DISTRIBUTION AND CONTROL OF WORK?
- HOW DOES HIS (INTERVIEWEE'S) SEGMENT OF THE ACTIVITY START?
- WHAT DOES HE OR HIS GROUP CONTRIBUTE TO THE PROCESSING?
- WHAT IS HIS CONNECTION WITH THE NEXT ACTIVITY?
- HOW DOES HE PASS ON HIS END PRODUCT?
- WHERE DOES IT GO?
- WHAT ARE FORMAL AND INFORMAL ORGANIZATIONAL RELATIONSHIPS?
  - TO WHOM DO EMPLOYEES GO FOR DECISIONS, OPERATIONAL INFORMATION, GUIDANCE?

(CONTINUED NEXT PAGE)

- WHO ASSIGNS/REVIEWS WORK?
- SPAN OF CONTROL?
- DOES EMPLOYEE EXERCISE INDEPENDENCE OF JUDGEMENT AND APPROVAL AUTHORITY?
- ARE SUPERVISORY RELATIONSHIPS CLEARLY ESTABLISHED?

INTERVIEW GUIDE FOR SHA's CONSTRUCTION MANAGEMENT SYSTEM

1. What are your actual position responsibilities?
2. Are your responsibilities and authorities sufficient to handle the job properly?
3. What documentation do you make of inspections?
4. When problems are identified, how do you handle them? Documentation? Follow-up?
5. Do you feel that you supervise too many people? Too few? Or is there too much construction supervision? Not enough? Are the duties of your subordinates equitably and logically staffed?
6. Is there overstaffing or understaffing?
7. Is proper and adequate training available to accomplish your job effectively?
8. What additional skills would help you accomplish your job more effectively? Is there anything that impedes accomplishing your job effectively?
9. At what level are key inspection elements being reviewed?
10. How is time divided among your various duties?

- Remember guide is only a guide - use it with common sense
  - Purpose is to aid you in covering all areas
    - Don't read questions verbatim
    - Be alert to other possible problem areas
- Selectively Interview people
  - Generally start at top of hierarchy - chief of unit
  - Get mix of old hands, new employees, etc.
  - Need to get a complete picture
- Make arrangements for interview
- Keep appointment
- Add & Delete from guide as needed

  (For planning purposes - 4 hours per interview)

REMINDER

- Avoid Commitments on Specific Recommendations
- Accurate Interpretations and Recorded
- Taking Notes - Complete after Interview
- Telephone Interviews - not very effective
- Don't issue Interview Guide in Advance
- Selling Ideas - NOT A CRUSADER
- Flexibility (guide)
- Ask Questions on Problems and Ideas for Improvement

LISTENER'S QUIZ

WHEN TAKING PART IN AN INTERVIEW OR GROUP CONFERENCE DO YOU:

	USUALLY	SOME TIMES	SELDOM
1. Prepare yourself physically by sitting facing the speaker and making sure that you can hear him?			
2. Watch the speaker as well as listen to him?			
3. Decide from the speaker's appearance and delivery whether or not what he has to say is worthwhile?			
4. Listen primarily for ideas and underlying feelings?			
5. Determine your own bias, if any, and try to allow for it?			
6. Keep your mind on what the speaker is saying?			
7. Interrupt immediately if you hear a statement you feel is wrong?			
8. Make sure before answering that you've taken in the other person's point of view?			
9. Try to have the last word?			
10. Make a conscious effort to evaluate the logic and credibility of what you hear?			

10 TIPS TO GOOD LISTENING

1. Listen Optimistically
2. Judge Content, not Delivery
3. Don't Jump to Conclusions
4. Listen for Ideas
5. Adjust Note-taking to Speaker's Style
6. Work at Listening
7. Concentrate — Resist Distractions
8. Excercise Your Mind
9. Keep an Open Mind
10. Don't Let Your Thoughts Wander

STEPS TO A SUCCESSFUL INTERVIEW

1. IDENTIFY DATA NEEDS

2. FAMILARIZE YOURSELF WITH AREA

3. PREPARE INTERVIEW GUIDE (CHECKLIST)
   - MIX OF GENERAL & SPECIFIC QUESTIONS

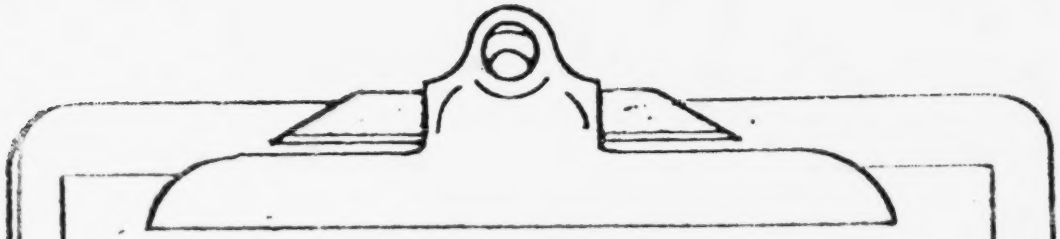
4. IDENTIFY KNOWLEDGABLE SOURCES

5. SCHEDULE AND PREVIEW INTERVIEW

7. CONDUCT INTERVIEW
   - PRIVACY
   - RAPPORT
   - SEEKING INFORMATION AND IDEAS AND VERIFICATION

8. COMPLETE AND/OR SUMMARIZE NOTES

9. (REVISE/MODIFY INTERVIEW GUIDE)



POINTS TO REMEMBER DURING EVERY INTERVIEW

1. LISTEN
2. AVOID EXTRANEOUS CONVERSATION
3. NOTE CRITICISM
4. ALLOW TIME TO ANSWER QUESTIONS
5. AVOID EXTERNAL DISTRACTIONS
6. AVOID INTERNAL DISTRACTIONS
7. DISTINGUISH FACT FROM OPINION
8. AVOID SARCASM, JOKES, AND OTHER HUMOR
9. GIVE FULL ATTENTION
10. ASK FOR MEANINGS
11. AVOID CONTRADICTING RESPONDENT
12. AVOID PERSONALITY CLASHES
13. ESTABLISH NUMBER OF INTERVIEWS PER DAY AND THE TIME LIMIT FOR EACH ONE
14. AVOID READING THE QUESTIONS
15. LEAVE OPEN THE POSSIBILITY OF FUTURE CONTACT
16. HONOR CONFIDENTIAL REMARKS

QUESTIONNAIRE

1. ADVANTAGES

   A. QUICKER WHEN RESPONSES FROM LARGE NUMBER OF PEOPLE ARE REQUIRED

   B. PERMITS CONVENIENT TABULATION OF DATA WHEN PROPERLY FORMATED

   C. MAY BE BEST WAY OF REACHING PEOPLE REMOTE TO THE STUDY LOCATION

   D. ALLOWS THE RESPONDENT TIME TO ANSWER DETAILED QUESTIONS

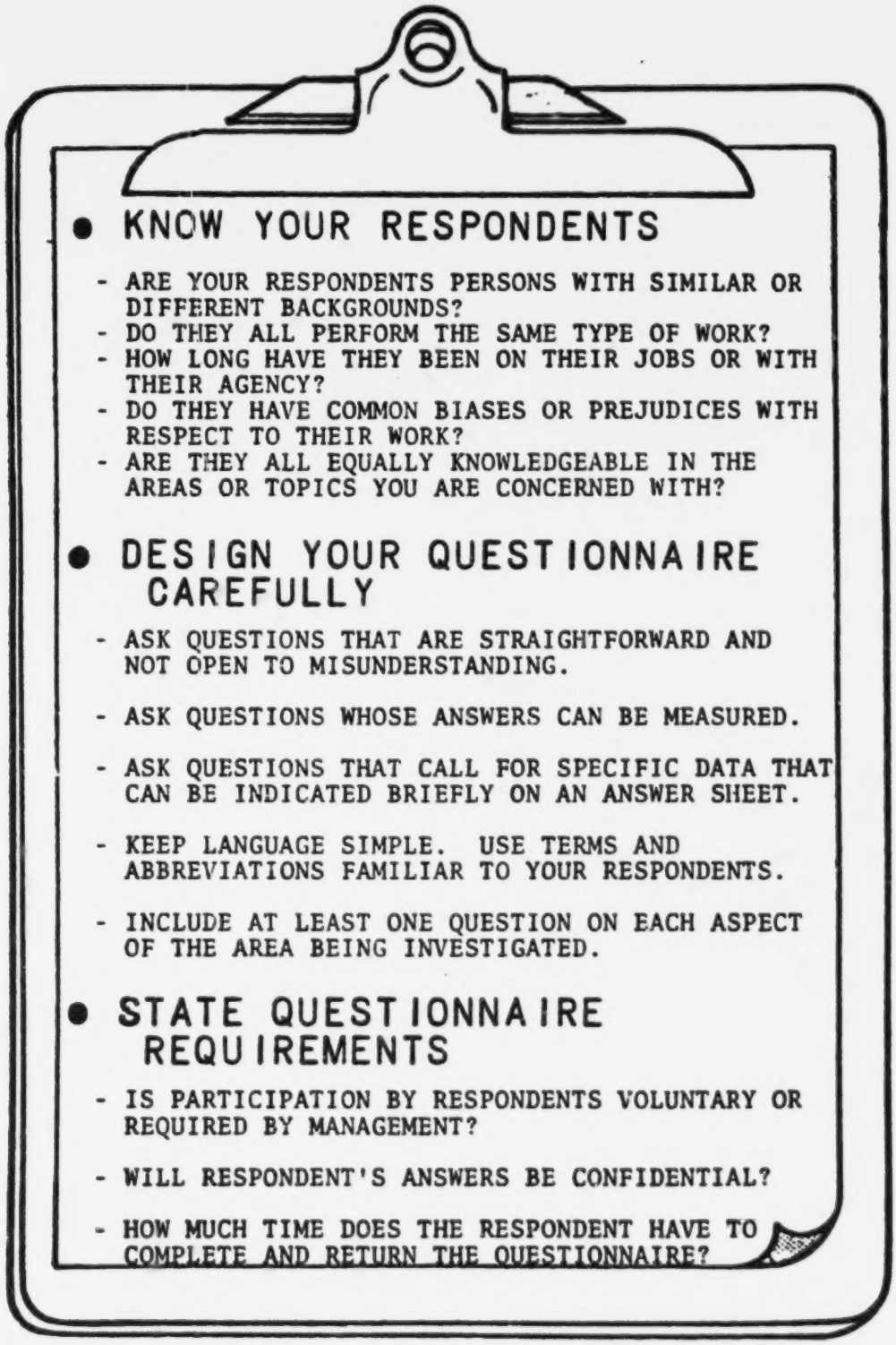
2. LIMITATIONS

   A. QUESTIONS MAY BE SUBJECT TO INTERPRETATION

   B. RESPONSES MAY NOT BE REPRESENTATIVE OF THE MAJORITY (ONLY THOSE WITH A SPECIAL INTEREST MAY REPLY)

   C. QUESTIONNAIRES FAIL TO DISCLOSE "OFF-THE-RECORD" INFORMATION

   D. MANY PEOPLE HAVE A PHOBIA OF QUESTIONNAIRES



• KNOW YOUR RESPONDENTS

- ARE YOUR RESPONDENTS PERSONS WITH SIMILAR OR DIFFERENT BACKGROUNDS?
- DO THEY ALL PERFORM THE SAME TYPE OF WORK?
- HOW LONG HAVE THEY BEEN ON THEIR JOBS OR WITH THEIR AGENCY?
- DO THEY HAVE COMMON BIASES OR PREJUDICES WITH RESPECT TO THEIR WORK?
- ARE THEY ALL EQUALLY KNOWLEDGEABLE IN THE AREAS OR TOPICS YOU ARE CONCERNED WITH?

• DESIGN YOUR QUESTIONNAIRE CAREFULLY

- ASK QUESTIONS THAT ARE STRAIGHTFORWARD AND NOT OPEN TO MISUNDERSTANDING.
- ASK QUESTIONS WHOSE ANSWERS CAN BE MEASURED.
- ASK QUESTIONS THAT CALL FOR SPECIFIC DATA THAT CAN BE INDICATED BRIEFLY ON AN ANSWER SHEET.
- KEEP LANGUAGE SIMPLE. USE TERMS AND ABBREVIATIONS FAMILIAR TO YOUR RESPONDENTS.
- INCLUDE AT LEAST ONE QUESTION ON EACH ASPECT OF THE AREA BEING INVESTIGATED.

• STATE QUESTIONNAIRE REQUIREMENTS

- IS PARTICIPATION BY RESPONDENTS VOLUNTARY OR REQUIRED BY MANAGEMENT?
- WILL RESPONDENT'S ANSWERS BE CONFIDENTIAL?
- HOW MUCH TIME DOES THE RESPONDENT HAVE TO COMPLETE AND RETURN THE QUESTIONNAIRE?

WHEN TO USE A QUESTIONNAIRE

1. RESPONDENT POSSESSES A WORKING KNOWLEDGE OF THE AREA.
2. INFORMATION IS QUANTIFIABLE.
3. INFORMATION IS LENGTHY.
4. QUESTIONNAIRE IS MOST SUITABLE MEANS AVAILABLE.
5. ACCURACY REQUIREMENTS ARE NOT CRITICAL.
6. INFORMATION LENDS ITSELF TO SCIENTIFIC SAMPLING TECHNIQUES.
7. LARGE CROSS-SECTION OF DATA IS NEEDED.

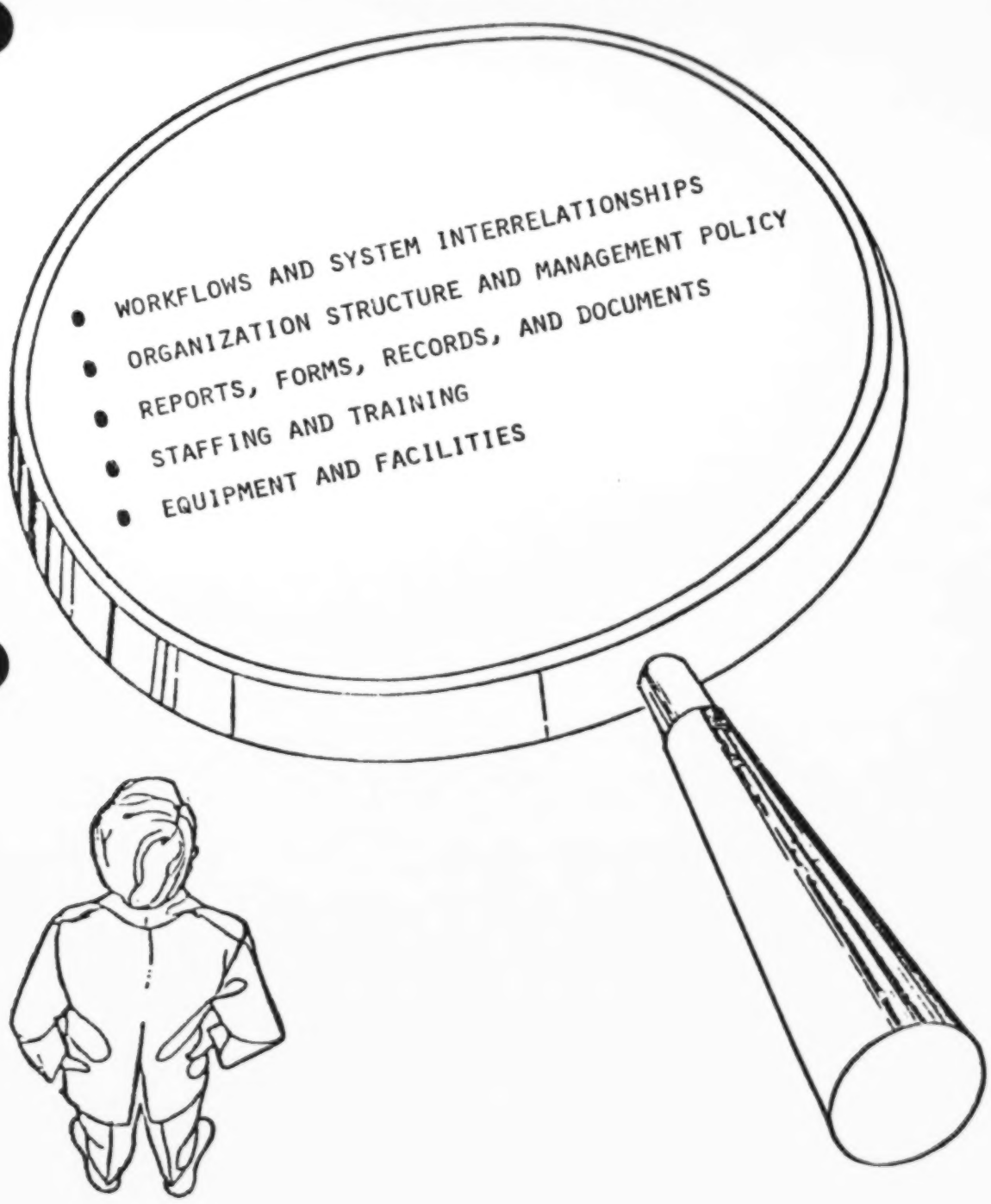
PERSONAL OBSERVATION

1. ADVANTAGES
   - A. POSITIVE MEANS OF MEASURING THE DEPENDABILITY OF FACTS
   - B. BEST WAY OF CORRECTING HAZY UNDERSTANDINGS
   - C. PROTECT THE SOURCES OF "OFF-THE-RECORD" INFORMATION
   - D. GOOD MEANS FOR OBSERVING AREAS FOR FUTURE SURVEYS

2. LIMITATIONS
   - A. COSTLY IN TERMS OF TIME
   - B. OBSERVED CONDITIONS MIGHT NOT BE TYPICAL CONDITIONS
   - C. PRESENCE OF REVIEW STAFF MAY DISTURB THE OPERATION
   - D. MAY DELAY CONCLUSIONS TOO LONG

PERSONAL OBSERVATION

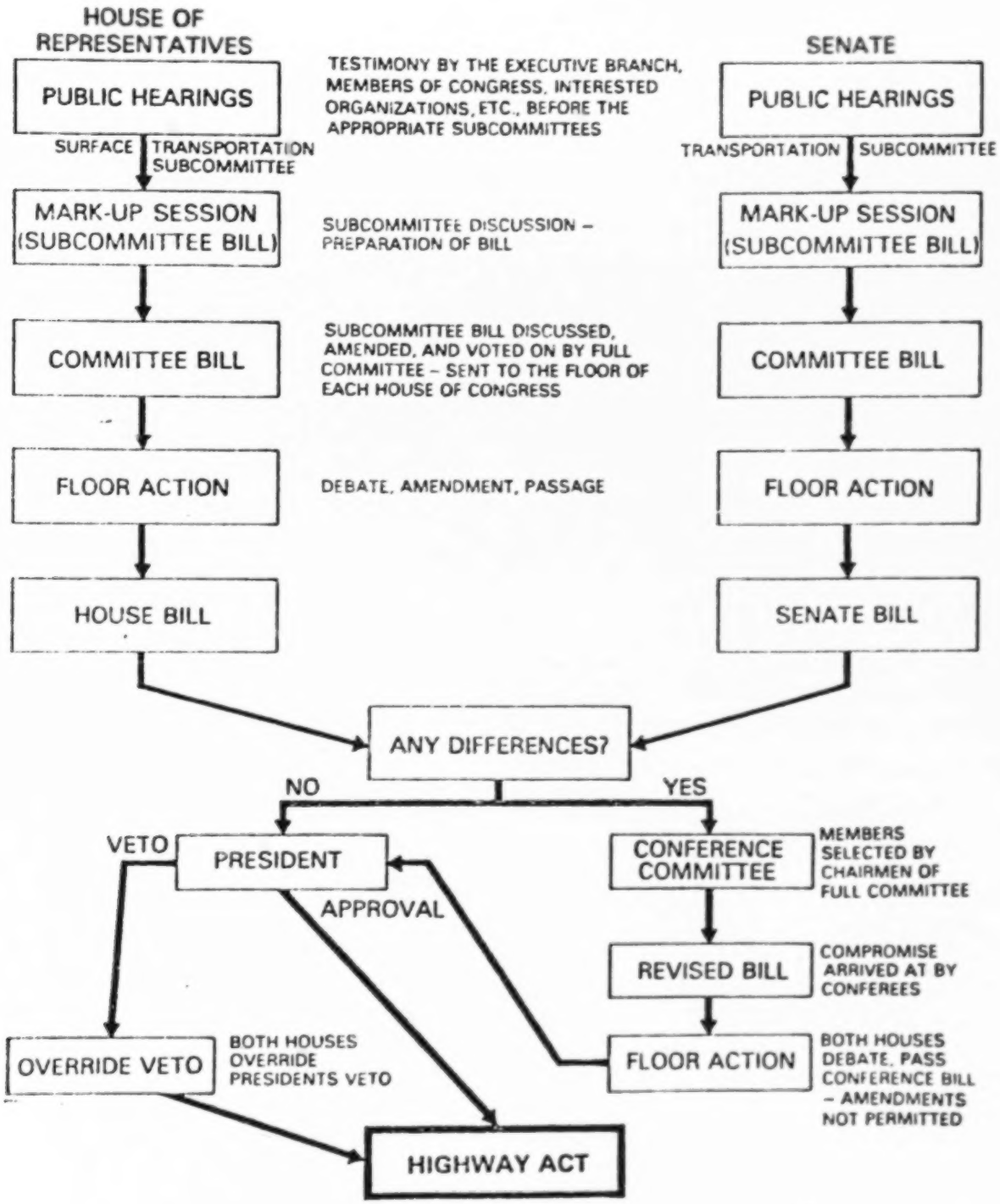
AREAS TO BE OBSERVED


• WORKFLOWS AND SYSTEM INTERRELATIONSHIPS
• ORGANIZATION STRUCTURE AND MANAGEMENT POLICY
• REPORTS, FORMS, RECORDS, AND DOCUMENTS
• STAFFING AND TRAINING
• EQUIPMENT AND FACILITIES

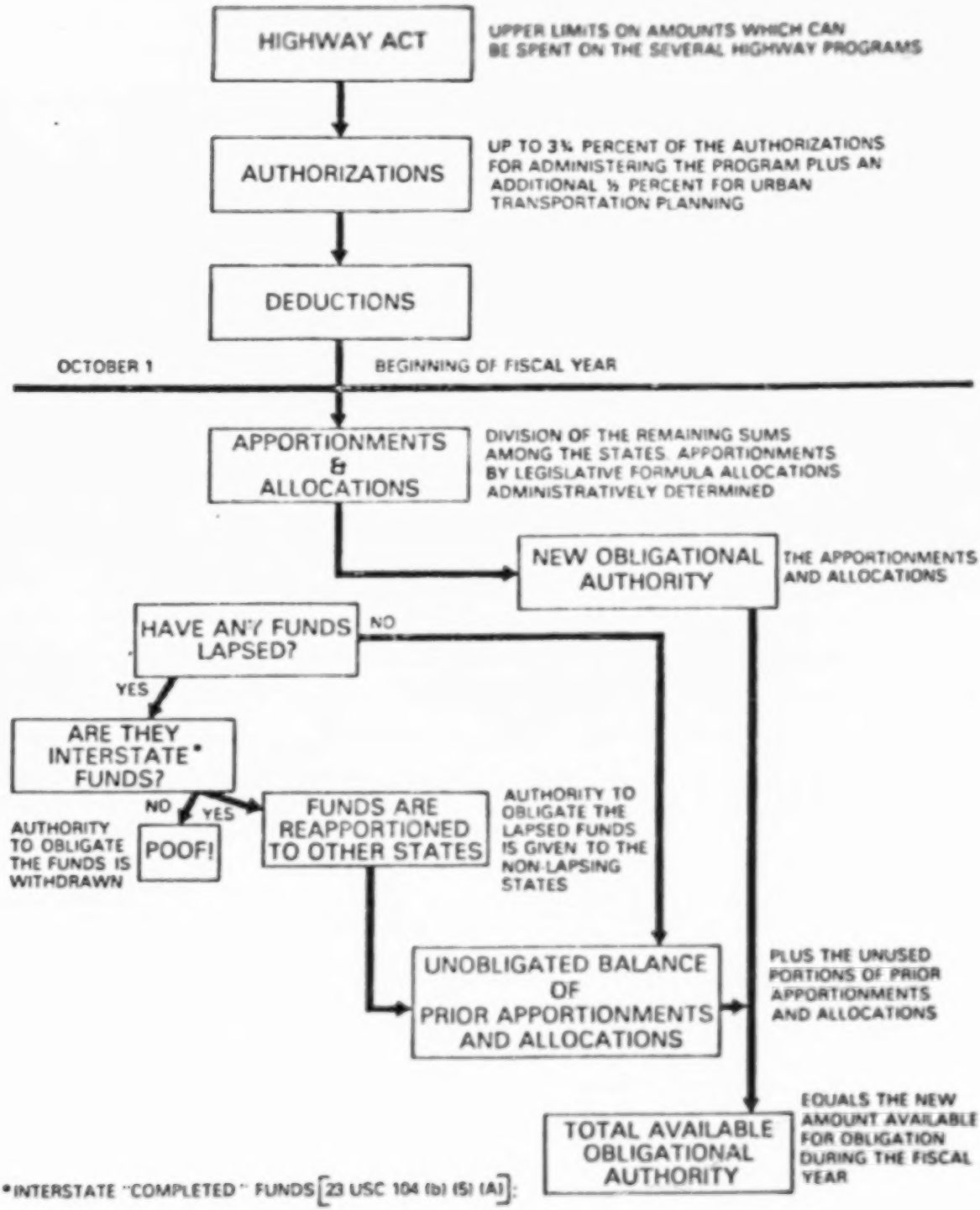
BENEFITS OF FLOW CHARTING

- SYSTEMATIC WAY OF OBTAINING AN ACCURATE DESCRIPTION OF A PROCESS.
- PINPOINTS DUPLICATION OF EFFORT
- FACILITATES SUBSEQUENT ANALYSIS
- PROVIDES A QUICK, DETAILED REFERENCE
- CAN BE USED BY SOMEONE NOT FAMILIAR WITH THE ACTIVITY
- PERMITS EXPERIMENTATION IN DEVELOPING NEW FLOW PROCESSES

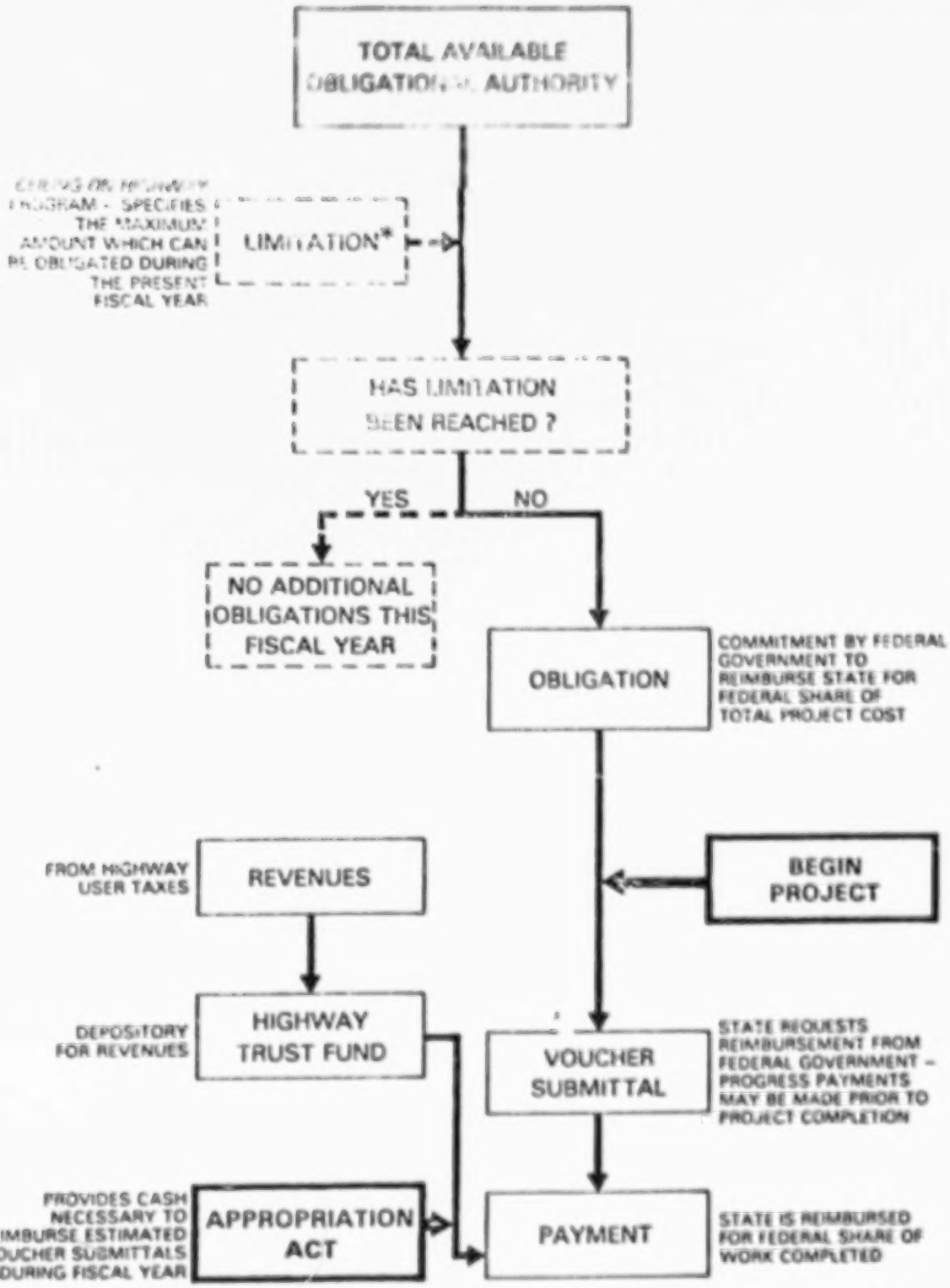
CONGRESSIONAL PROCEDURES
(SIMPLIFIED, TYPICAL PROCESS)



FINANCIAL PROCEDURES


HIGHWAY ACT
UPPER LIMITS ON AMOUNTS WHICH CAN BE SPENT ON THE SEVERAL HIGHWAY PROGRAMS
AUTHORIZATIONS
UP TO 3¼ PERCENT OF THE AUTHORIZATIONS FOR ADMINISTERING THE PROGRAM PLUS AN ADDITIONAL ½ PERCENT FOR URBAN TRANSPORTATION PLANNING
DEDUCTIONS
OCTOBER 1
BEGINNING OF FISCAL YEAR
APPORTIONMENTS & ALLOCATIONS
DIVISION OF THE REMAINING SUMS AMONG THE STATES. APPORTIONMENTS BY LEGISLATIVE FORMULA ALLOCATIONS ADMINISTRATIVELY DETERMINED
NEW OBLIGATIONAL AUTHORITY
THE APPORTIONMENTS AND ALLOCATIONS
HAVE ANY FUNDS LAPSED?
NO
YES
ARE THEY INTERSTATE* FUNDS?
NO
YES
AUTHORITY TO OBLIGATE THE FUNDS IS WITHDRAWN
POOF!
FUNDS ARE REAPPORTIONED TO OTHER STATES
AUTHORITY TO OBLIGATE THE LAPSED FUNDS IS GIVEN TO THE NON-LAPSING STATES
UNOBLIGATED BALANCE OF PRIOR APPORTIONMENTS AND ALLOCATIONS
PLUS THE UNUSED PORTIONS OF PRIOR APPORTIONMENTS AND ALLOCATIONS
TOTAL AVAILABLE OBLIGATIONAL AUTHORITY
EQUALS THE NEW AMOUNT AVAILABLE FOR OBLIGATION DURING THE FISCAL YEAR

*INTERSTATE "COMPLETED" FUNDS [23 USC 104 (b) (5) (A)]:


TOTAL AVAILABLE OBLIGATIONAL AUTHORITY
LIMITATION*
THE MAXIMUM AMOUNT WHICH CAN BE OBLIGATED DURING THE PRESENT FISCAL YEAR
HAS LIMITATION BEEN REACHED ?
YES
NO
NO ADDITIONAL OBLIGATIONS THIS FISCAL YEAR
OBLIGATION
COMMITMENT BY FEDERAL GOVERNMENT TO REIMBURSE STATE FOR FEDERAL SHARE OF TOTAL PROJECT COST
FROM HIGHWAY USER TAXES
REVENUES
BEGIN PROJECT
DEPOSITORY FOR REVENUES
HIGHWAY TRUST FUND
VOUCHER SUBMITTAL
STATE REQUESTS REIMBURSEMENT FROM FEDERAL GOVERNMENT – PROGRESS PAYMENTS MAY BE MADE PRIOR TO PROJECT COMPLETION
PROVIDES CASH NECESSARY TO REIMBURSE ESTIMATED VOUCHER SUBMITTALS DURING FISCAL YEAR
APPROPRIATION ACT
PAYMENT
STATE IS REIMBURSED FOR FEDERAL SHARE OF WORK COMPLETED

*LIMITATION MAY BE INITIATED BY THE EXECUTIVE BRANCH OR THE CONGRESS

FLOWCHARTING GUIDELINES

- Tracing a process through each specific step from start to finish facilitates organized analysis of a process. Process charting can show quickly and in detail the sequence of a particular activity. There are a number of different symbols and sets of symbols that can be used to diagram a process. Of prime importance is that the chart is understandable to you and to anyone else who may read it.

- Determining the process flow may benefit the reviewer in especially critical or complex areas such as the following:
  - Inspection Testing:
    - What happens on a failing test?
    - What are steps in process leading to test?
    - What process is followed to correct deficiencies?
  - Specification assurances:
    - What steps are taken to assure project is being built to specifications? Follow from central office to district office to project office -
    - What do central office people do?
    - What do district office people do?
    - What do project office people do?
  - Construction Management responsibilities:
    - What are lines of authority (responsibility) from central office to individual inspector?

TABLE OF RANDOM NUMBERS

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104	150	015	020	816	916	691	141	625	362	209	995	912	907	223
465	755	853	309	891	279	534	939	340	526	191	396	995	241	493
225	972	763	648	151	248	493	320	306	196	633	586	421	930	062
616	078	163	394	535	713	570	008	749	977	163	375	399	818	166
061	917	604	813	496	606	141	069	012	546	779	069	110	427	277
534	186	706	906	150	219	818	443	426	995	729	554	699	588	310
711	187	440	483	632	210	106	129	963	919	054	079	188	209	945
568	690	600	184	849	425	323	895	143	636	102	174	181	577	843
253	125	586	449	055	569	854	368	533	539	530	595	388	623	081
179	164	114	185	649	289	695	882	332	709	799	568	058	901	315
015	855	916	781	635	409	482	034	496	634	186	726	521	208	122
905	337	903	094	939	526	927	889	334	363	176	300	082	841	271
306	749	103	611	875	858	482	522	676	933	015	263	851	202	299
898	071	973	710	081	772	139	475	810	977	859	293	744	285	907
510	127	518	512	774	163	607	921	424	539	709	539	756	407	023
213	524	602	893	198	553	448	011	652	648	449	059	551	010	540
333	949	312	041	185	298	715	850	511	019	927	649	521	539	463
585	232	145	831	987	234	643	947	177	351	357	070	976	337	099
426	066	769	136	518	461	889	195	256	581	486	912	858	143	091
301	902	047	591	221	304	616	999	328	541	584	224	741	470	253
764	263	581	066	215	152	969	445	326	323	055	242	133	380	943
287	358	069	170	641	182	228	293	270	876	873	587	002	458	153
465	411	103	076	361	185	024	330	288	073	197	924	609	612	500
676	325	866	507	949	132	168	741	920	246	366	007	228	021	516
072	765	972	459	212	003	304	038	946	894	415	175	273	639	415
491	822	241	990	478	810	649	662	804	657	832	341	132	305	977
358	919	001	509	986	384	878	946	397	574	675	776	443	112	711
110	605	064	287	378	079	987	985	271	312	806	444	978	704	954
145	507	354	590	875	481	029	009	481	047	212	208	929	902	124
250	011	386	281	680	109	100	542	064	508	654	793	538	106	218
724	779	565	555	873	696	451	003	257	008	968	306	476	231	395
569	206	217	517	331	726	326	415	761	915	211	362	278	739	206
378	638	710	847	524	223	780	174	961	183	709	669	997	724	011
421	113	207	543	369	700	232	654	596	996	947	114	181	813	804
906	525	020	851	885	478	002	825	720	157	438	998	104	769	259
035	215	834	439	907	229	442	240	655	857	558	388	593	137	351
013	395	762	224	832	322	795	290	041	162	153	128	662	383	224
733	887	094	825	052	926	826	270	325	170	276	982	638	119	346
880	561	349	570	239	258	400	670	122	027	148	232	350	997	375
116	355	851	099	963	059	979	283	141	008	807	704	756	767	887
378	401	590	333	266	622	699	761	508	438	866	709	793	938	281
192	687	695	859	496	467	633	566	004	733	914	152	069	570	541
179	008	643	607	889	610	997	306	264	115	443	347	603	609	719
602	635	711	056	438	582	261	321	634	354	571	109	073	546	936
851	643	291	443	144	552	787	341	303	484	513	095	259	276	112
652	528	508	222	055	995	737	857	292	703	602	163	198	428	092
432	470	426	456	000	206	146	499	945	563	596	091	580	290	443
457	707	056	490	269	574	992	241	746	756	296	392	528	627	726
980	672	727	018	134	146	876	897	139	778	691	700	354	345	154
813	587	354	948	755	006	977	966	864	964	864	544	964	554	413

Types of Sampling Procedures

There are a number of different types of sampling procedures, each of which has advantages for certain purposes. The more commonly used types of sampling are: simple random sampling, systematic sampling, stratified sampling, and cluster sampling.

A brief description of each of these follows:

Simple Random Sampling. In this procedure, the items included in the sample are drawn completely at random from the entire universe. A common procedure for making this random selection is: first, assign a serial number to each item in the universe; then, using a table of random numbers, make a random selection of the serial numbers (and associated items) to be included in the sample.

Systematic Sampling. In systematic sampling, the sample items are selected from the array of items in the universe in such a way that there is a uniform interval between each sample item and the next sample item. For example, if a sample is to include 1 of every 100 items in the universe, the selection would be made by first drawing an item at random from the first 100 items in the universe, and then selecting every 100th item thereafter.

Stratified Sampling. In stratified sampling, the items in the universe are first segregated into two or more classes called strata. Usually these are chosen so that items which are generally comparable in the characteristic being measured fall within the same stratum. Then each stratum is sampled independently and the results for the several strata are weighted together to give an over-all figure for the universe. This type of sampling is often appropriate when there is wide variation among the sampled items in the characteristic to be measured.

Cluster Sampling. In this type of sampling, the universe is formed into groups or "clusters" of items. The first step is to make a random selection of clusters to include in the sample. Then, the items within the selected clusters may be sampled or a census may be taken of them. This type of sampling is often advantageous for cost reasons. For example, in surveying households, travel costs can often be reduced by the use of cluster sampling.

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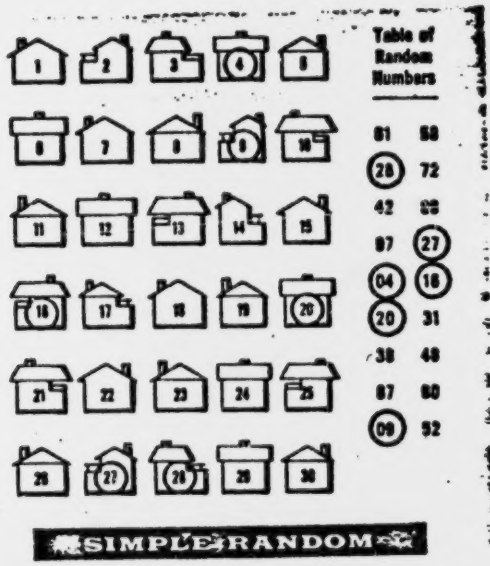
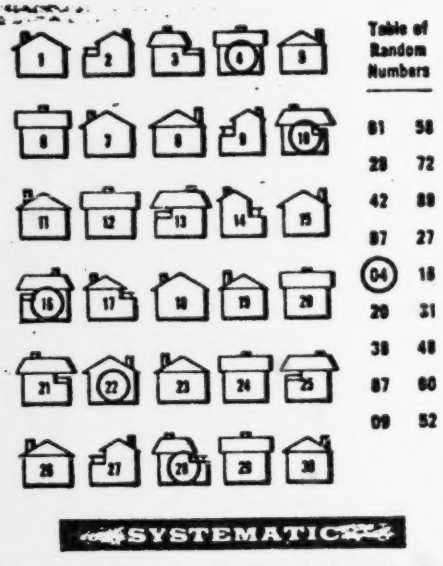


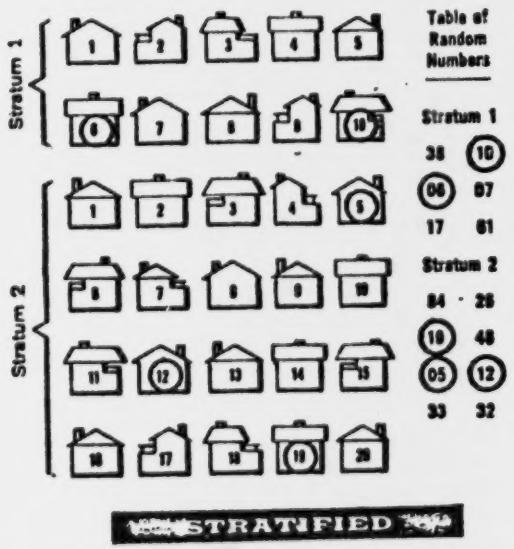
SIMPLE RANDOM

Starting anywhere in a table of random numbers, all numbers of 30 and lower are taken consecutively until required size of sample is reached (six households, in this illustration).



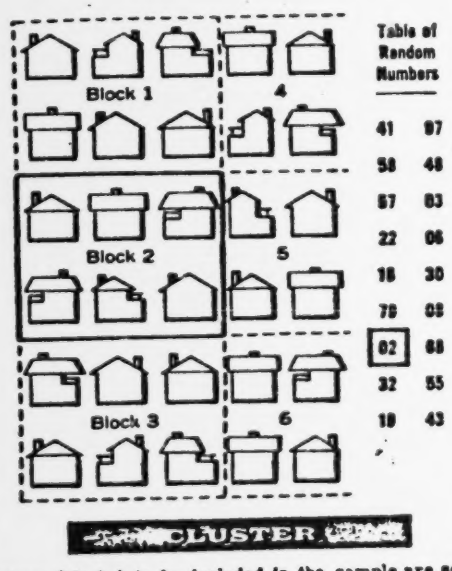
SYSTEMATIC

Calculated sample size (in this case, five) requires taking every sixth household. Random start is determined by taking first number of 6 or below from table entered at random.



STRATIFIED

Households are stratified by some criterion such as type of telephone service. Then, the sample is selected by an appropriate method in each of the strata independently.



CLUSTER

Clusters (blocks) to be included in the sample are selected by means of a table of random numbers. Then, a census (or a sample) is taken of the households in these selected blocks.

STEPS TO SUCCESSFUL SAMPLING

- Pre-Determine Exactly What Information is Wanted from the Study
  - Essential to Define Population (Documents, Projects, Etc.)
  - What Questions Do You Intend to Answer
  - How Will You Use the Results

- Work Out Most Efficient and Economic Sample Design
  - Simple Random Sampling
  - Stratified

- Tailor Design to Fit Conditions Surrounding Study
  - What Features/Factors are You Looking At
    - Project Size
    - Project Type
    - Geographical Location
    - Urban/Rural
    - Contractor/Sub-Contractor

- Insure Random Selection of Sampling Units

Sampling for Attributes

Foreword

Sampling for attributes (termed by statisticians either survey or estimation sampling for attributes) is one of the most widely used sampling plans available to the reviewer, and probably the most versatile. Its function is to determine "how many." It is used to estimate the probable frequency with which a certain event occurs. This event may be a particular class of error or other "attribute" of the population. Sampling for attributes is applicable when the objectives of an evaluation can be met by a yes or no, right or wrong, black or white, answer.

This chapter is concerned with the method of determining the appropriate sample size to achieve the desired results for a review involving attributes sampling.

Review Considerations

The mechanics of determining the required sample size of attributes sampling have been simplified by the development of tables for that purpose. Considerable judgement must be exercised by the reviewer, however, in making certain decisions before the tables may be used. These include decisions about the confidence level desired, the stipulated precision or reliability of the sample results, and the expected error rate.

Confidence Level - The probability that the value obtained by a sample will not differ from the true value of the universe by more than a stated amount (precision). This is ordinarily expressed as a percentage. Thus, a confidence level of 90% means that there are 90 chances in 100 that the sample is representative and 10 chances that it is not.

Precision - A range (ordinarily expressed as plus or minus a given number of precentage points) within which the true answer concerning the population characteristic under study (errors, for example) should fall at a specified confidence level. Thus, if the reviewer says on the basis of his test that the projected error rate in a given population is 5%, $\pm$ 2%, he means that the error rate in the population may be as low as 3% or as high as 7%.

Expected Error Rate - The percentage of error that the reviewer believes will be found as the result of a test. In estimating the error rate, the reviewer may be guided by the results of a previous review, by discussion with the client, by a preliminary survey, or by a small pilot test of transactions which can then be incorporated in the full-scale test. The reviewer should be realistic in estimating the expected error rate, but when in doubt should lean toward the high side. Thus, by overestimating the error rate, he will select a few more sample items initially and will not be forced to return for additional items later.

Determination of Sample Size

Once these decisions as to the confidence level, precision, and expected error rate have been made, the only other information the reviewer needs to determine the sample size is the approximate size of the universe or population from which the sampling is to be made.

It is absolutely essential that the reviewer at the outset define the population precisely; that is, that he know exactly what individual elements comprise the population he is going to sample. The composition of the population to be sampled must be considered in the light of the objective of the test. For example, if the test objective is to determine the number or disbursement documents that are missing from a file of these documents arranged in numerical sequence, the document itself becomes the sampling unit and the total number of documents to be filed represents the population. On the other hand, if the test objective is to determine whether the entries on the disbursement documents are complete and accurate, each entry or line item on the document becomes a sampling unit and the total number of entries or line items represents the population. From this example it can be seen that the precise identification of the population to be sampled is extremely important if the sample test results are to answer the review objective. If statistical sampling is applied to a population that is not properly defined, unsatisfactory test results may be obtained from which erroneous conclusions might be drawn.

t this point, after the reviewer has defined the population being sampled, he can go to the various tables that are available and determine the appropriate sample size. Table A is provided to aid the reviewer in making this determination. This table shows the appropriate sample sizes based on various population sizes, degrees of confidence and precision, and maximum expected error rates. To select the sample size for a specific audit test, the reviewer should turn to that section of the table that corresponds to the maximum expected error rate and the selected confidence level. He should then locate the precision percentage desired and follow the column downward to the line that most nearly corresponds to the estimated population size. The number appearing at the intersection of the population size and the precision percentage selected is the sample size to be used. (If the exact population size being sampled does not appear in the table, the reviewer should use the next higher population shown, or interpolate, depending on the difference between the sample sizes listed in the table.)

Example of Attributes Sampling

As an illustration of how the sample size can be determined, using Table A.5 let's consider the following example. Assume that the purpose of the reviewer is to determine how many errors were made in the identification numbers assigned to a certain type of document. The reviewer has determined the population size to be 7,000 documents and the expected error rate to be no more than 5%. He wishes to be 90% confident that the results of his tests are within ±3% (precision range) of the true error rate. He

therefore turns to the table showing the expected error rate of not over 5% and a confidence level of 90%. By reading downward in the 3% precision column to the intersection with the line showing a population size of 7,000, he finds that the size of the sample that should be tested is 139. Had the reviewer been satisfied with a precision range of + 4%, the sample size would have been . On the other hand, if he had desired a precision range of ± 2%, the sample would have been 320.

It should be pointed out that the sample size obtained by these procedures gives an estimated size only. After the sample precision is re-evaluated (see the following subsection) the reviewer may determine whether or not the size of the sample was adequate. Generally speaking, it may be stated that if the error rate disclosed by the sample exceeds the expected error rate, the sample size determined from the tables may be too small. If, on the other hand, the sample error rate is less than the expected error rate, no additional sampling is required.

Re-evaluating the Sample Precision

Sampling for attributes, as you have just seen, permits the reviewer to project his sample results to the entire population with a determinable degree of mathematical assurance. Before making this projection, however, he will have to re-evaluate the sample precision as a result of his findings.

As stated earlier in this chapter, sampling for attributes takes into consideration three premises: confidence level, precision, and expected error rate. But since the expected error rate is seldom more than an educated guess, there is a high probability that the actual error rate found in the sample will vary in some degree from the expected error rate. And because precision (based on the confidence level selected) and error rate are inextricably bound together, any change in one affects the other.

For example, let us say that a sample of 198 has been selected from a population of 9,000 because the reviewer, assuming an error rate in to exceed 5%, wanted to have 95% assurance that the true error rate in the population was not more than 8% or less than 2% (a precision of ± 3%). Now, if the reviewer finds that the actual error rate in his sample is 10%, what is the estimate of the true error rate in his population? Is it still to be based on a precision of ±3%? The answer is No; because the tables from which the sample of 198 was selected were based on an error rate of 5%, not on an error rate of 10%.

Special tables have been devised, however, which can tell the reviewer what his new precision is when the actual error rate found in his sample differs from the expected error. (See Tables F.1 through F.5.) These five tables cover actual error rates of 2%, 3%, 5%, 10%, and 15%.

The first columns in each table indicates the sample sizes. The remaining columns are headed by universe sizes of 500, 1,000, 2,000, 10,000, and 50,000 and over. Under each of these headings are shown the upper and ower limits of the precision ranges applicable to the sample sizes selected. Separate tables are included for confidence levels of 90% and 95%. If the sample size selected is not found in these tables, use a simple linear interpolation.

There is generally no need to interpolate for universe sizes not shown in the tables, since the precision ranges vary hardly at all among the universe sizes that are shown. For example, where the actual error rate is 2%, and the sample size is 500 for a confidence level of 90% (Table F.1), the range for a universe of 2,000 is 1.3% to 3.2%, while the range for a universe of 50,000 and over is 1.2% to 3.3%.

It is always possible, of course, that a reviewer will find no errors in the sample he has examined. This does not mean that he can conclude that there are no errors in the universe from which the sample was taken. It is quite conceivable for a large number of errors to exist in a universe but not to show up in a sample--particularly when the sample is small. A special table has been devised to show the precision range when a sample discloses none of the events tested for. (See Table F.6.) This table shows only one limit--the upper limit--since it is likewise possible that the universe does indeed contain no errors.

The following three examples show how Tables F.1 through F.5 and Table F.6 can be used.

Example 1

Let us assume a test in which the reviewer expects an error rate of not to exceed 5% for a population of 9,000 items, a precision of +3%, a confidence level of 95%, and a sample size of 198 items. If the actual error rate in the sample proves to be 5%, as expected, the reviewer would be sure that 95 times out of 100 the error rate would fall between 2% and 8%.

Suppose, however, that the sample of 198 items disclosed an error rate of 10% instead of 5%. Since the 10% actual rate has exceeded the expected 5% rate, the precision range associated with the 5% error rate does not apply.

The revised precision range can be determined from Table F.4, where the precision range for universe sizes of 10,000, a sample size of 198, an error rate of 10%, and a confidence level of 95%, is 6.3% to 15.0%.

Example 2

Let us assume that the reviewer is testing a population of 18,000 and expects an error rate not to exceed 3%, with a precision range of ±2%, and a confidence level of 95%. The sample size would be 275.

Let us further assume that the test discloses an error rate of 5%. The reviewer then has to determine the new range of precision.

Table F.3 shows precision ranges for samples of 250 and 300, but not for 275. The reviewer will therefore have to interpolate. The Table F.3 gives the following precision limits for the sample sizes on either side of 275 (using the universe size of 50,000 and over, to be conservative).

Sample Size	Limit	
	Lower	Upper
250	2.7%	8.5%
300	2.8	8.1

The difference between the sample size of 275 and the next lower sample size given (250) is 25. The difference between sample sizes 250 and 300 is 50. Accordingly, one half (25/50) of the difference of the precision ranges given may be added to the smaller of the values involved to arrive at the lower limit as follows:

Lower limit for sample size of 300	2.8%
Lower limit for sample size of 250	2.7
Difference	.1%
50% of difference	.05%
Add lower limit for smaller sample size	2.70
Lower limit for sample size of 275	2.75%

A similar computation is made for the upper limit:

Upper limit for sample size of 250	8.5%
Upper limit for sample size of 300	8.1
Difference	.4%
50% of difference	.2%
Add upper limit for larger sample size	8.1
Upper limit for sample size of 275	8.3%

Example 3

Let us assume a test of a population of 50,000 items, where the expected rate or error is not over 5%, the confidence level is 95%, the precision range is +2%, and the sample size is 452. Let us further assume that the test discloses no errors and the reviewer wishes to determine the maximum error rate in the universe under those circumstances.

Table F.6 shows that for a population of 50,000 items, a confidence level of 95%, and a sample of 452 items, the maximum error rate in the population would be between .6% (sample of 500) and .7% (sample of 400). Thus, there are 95 chances out of 100 that the error rate in the population does not exceed about .65%.

TABLE A.1

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 2%

CONFIDENCE LEVEL 90%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS						
	0.50	0.75	1.00	1.25	1.50	1.75	2.00
50	48	47	45	43	41	38	36
100	95	90	84	77	70	63	57
150	140	129	116	104	91	80	70
200	182	165	145	125	108	92	79
250	223	197	169	143	121	102	86
300	262	227	191	159	132	109	91
350	300	255	210	172	140	115	96
400	336	280	228	183	148	120	99
450	371	304	243	193	154	125	102
500	404	326	257	202	160	128	104
550	436	347	270	209	165	131	106
600	467	366	281	216	169	134	108
650	497	384	292	222	172	136	110
700	526	401	301	228	176	138	111
750	554	417	310	233	179	140	112
800	580	432	318	238	182	142	113
850	606	447	326	242	184	143	114
900	631	460	333	246	186	145	115
950	656	473	340	250	188	146	116
1000	679	485	346	253	190	147	117
1100	724	507	357	259	194	149	118
1200	766	528	367	264	197	151	119
1300	806	546	376	269	199	152	120
1400	843	563	384	273	201	154	121
1500	878	578	391	276	203	155	121
1600	912	593	398	280	205	156	122
1700	943	606	404	282	207	157	123
1800	973	618	409	285	208	157	123
1900	1002	630	414	287	209	158	123
2000	1029	640	419	290	210	159	124
2250	1091	664	429	294	213	160	125
2500	1147	684	437	298	215	161	125
2750	1197	702	444	302	217	162	126
3000	1242	717	450	304	218	163	126
3250	1283	730	455	307	219	164	127
3500	1320	742	460	309	220	165	127
3750	1354	753	464	311	221	165	128
4000	1386	763	468	312	222	165	128
4250	1415	771	471	314	223	166	128
4500	1441	779	474	315	223	166	128
4750	1466	786	477	316	224	167	128
5000	1489	793	479	317	225	167	129
5500	1530	804	483	319	226	167	129
6000	1567	814	487	321	226	168	129
6500	1599	823	490	322	227	168	129
7000	1628	830	493	323	228	169	130
7500	1653	837	495	324	228	169	130
8000	1676	843	497	325	228	169	130
8500	1697	848	499	326	229	169	130
9000	1716	853	500	327	229	169	130

Source: Lockheed-Georgia Company, Math Analysis Group

Table A.2

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 2%

CONFIDENCE LEVEL 95%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS						
	0.50	0.75	1.00	1.25	1.50	1.75	2.00
50	49	48	46	45	43	41	39
100	96	93	88	82	76	71	65
150	142	134	125	114	103	93	83
200	187	174	158	141	125	110	96
250	230	210	187	164	143	123	107
300	272	245	214	184	158	135	115
350	313	277	238	202	171	144	122
400	353	307	261	218	182	152	128
450	391	336	281	232	191	158	132
500	428	364	300	245	200	164	136
550	465	389	317	256	208	169	140
600	500	414	333	267	214	174	143
650	534	437	348	276	220	178	145
700	567	459	362	285	226	181	148
750	600	480	375	293	231	185	150
800	632	500	387	300	235	188	152
850	662	519	399	307	240	190	154
900	692	538	409	313	243	193	155
950	722	555	420	319	247	195	157
1000	750	572	429	325	250	197	158
1100	805	603	446	335	256	200	160
1200	858	632	462	343	261	204	162
1300	908	659	476	351	266	206	164
1400	955	684	489	358	270	209	165
1500	1001	707	501	364	273	211	167
1600	1044	728	512	370	276	213	168
1700	1086	748	521	375	279	214	169
1800	1126	767	530	380	282	216	170
1900	1165	785	539	384	284	217	171
2000	1201	801	547	388	286	218	172
2250	1287	839	564	396	291	221	173
2500	1366	871	578	404	295	223	175
2750	1437	900	591	410	298	225	176
3000	1502	925	601	415	301	227	177
3250	1563	948	611	419	303	228	177
3500	1618	968	619	423	305	229	178
3750	1670	986	627	427	307	230	179
4000	1718	1002	633	430	308	231	179
4250	1762	1017	639	432	310	232	180
4500	1804	1031	645	435	311	233	180
4750	1843	1044	649	437	312	233	181
5000	1879	1055	654	439	313	234	181
5500	1946	1076	662	443	315	235	182
6000	2005	1094	668	446	316	236	182
6500	2058	1109	674	448	318	236	182
7000	2105	1123	679	450	319	237	183
7500	2148	1135	684	452	320	238	183
8000	2188	1146	688	454	321	238	183
8500	2223	1156	691	456	321	238	184
9000	2256	1165	694	457	322	239	184

Source: See first page of Table A.1

TABLE A.3

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 3%

CONFIDENCE LEVEL 90%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS						
	0.50	1.00	1.50	2.00	2.50	2.75	3.00
50	49	47	43	39	35	33	31
100	96	88	77	66	55	51	46
150	143	125	104	85	68	61	55
200	188	159	127	99	77	68	60
250	231	189	145	110	83	73	64
300	273	217	161	118	88	77	67
350	314	242	174	125	92	80	69
400	354	265	186	131	95	82	71
450	393	286	196	136	98	84	73
500	431	305	205	141	100	86	74
550	468	323	213	144	102	87	75
600	503	340	221	148	104	88	76
650	538	356	227	151	105	89	77
700	572	370	233	153	106	90	77
750	605	384	238	155	107	91	78
800	637	396	243	157	108	92	78
850	669	408	247	159	109	92	79
900	699	419	251	161	110	93	79
950	729	430	255	163	111	93	80
1000	759	440	259	164	111	94	80
1100	815	458	265	166	113	95	81
1200	868	475	270	169	114	95	81
1300	920	490	275	170	114	96	81
1400	969	503	279	172	115	96	82
1500	1016	516	283	174	116	97	82
1600	1061	527	287	175	116	97	82
1700	1104	538	290	176	117	98	83
1800	1145	547	293	177	117	98	83
1900	1185	556	295	178	118	98	83
2000	1223	564	297	179	118	98	83
2250	1312	583	302	181	119	99	84
2500	1393	598	307	182	119	99	84
2750	1468	612	310	183	120	100	84
3000	1536	623	313	184	120	100	85
3250	1599	633	315	185	121	100	85
3500	1657	642	318	186	121	101	85
3750	1711	650	320	187	121	101	85
4000	1762	657	321	187	122	101	85
4250	1809	664	323	188	122	101	85
4500	1852	670	324	188	122	101	85
4750	1893	675	325	189	122	101	85
5000	1932	680	327	189	122	102	85
5500	2002	688	329	190	123	102	86
6000	2065	696	330	190	123	102	86
6500	2121	702	332	191	123	102	86
7000	2172	707	333	191	123	102	86
7500	2218	712	334	191	123	102	86
8000	2259	716	335	192	124	102	86
8500	2298	720	336	192	124	102	86
9000	2333	724	336	192	124	102	86

Source: See first page of Table A.1

TABLE A.4

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 3%

CONFIDENCE LEVEL 95%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS 0.50	1.00	1.50	2.00	2.50	2.75	3.00
50	49	47	45	42	39	37	35
100	97	91	83	73	64	59	55
150	145	132	115	97	81	74	67
200	191	169	142	116	94	84	76
250	236	204	166	131	104	92	82
300	281	236	187	144	112	99	87
350	324	266	205	155	118	103	91
400	367	294	221	164	123	107	94
450	408	320	236	172	127	111	97
500	449	345	249	179	131	114	99
550	489	368	261	185	134	116	101
600	529	390	271	190	137	118	102
650	567	411	281	195	140	120	104
700	605	430	290	199	142	122	105
750	642	448	298	203	144	123	106
800	678	466	306	207	146	124	107
850	714	482	313	210	147	125	108
900	749	498	320	213	149	126	109
950	783	513	326	215	150	127	109
1000	817	527	331	218	151	128	110
1100	882	554	342	222	153	130	111
1200	946	578	351	226	155	131	112
1300	1007	601	359	230	157	132	113
1400	1066	621	366	232	158	133	114
1500	1123	640	373	235	159	134	114
1600	1178	658	379	237	160	135	115
1700	1231	674	384	240	161	135	115
1800	1283	689	389	241	162	136	116
1900	1333	703	393	243	163	137	116
2000	1381	717	397	245	164	137	116
2250	1496	746	406	248	165	138	117
2500	1603	772	414	251	166	139	118
2750	1702	794	420	253	167	140	118
3000	1795	814	426	255	168	140	119
3250	1882	831	430	257	169	141	119
3500	1963	847	435	258	170	141	119
3750	2039	861	438	260	170	142	120
4000	2111	873	441	261	171	142	120
4250	2178	885	444	262	171	142	120
4500	2242	895	447	263	172	143	120
4750	2303	904	449	263	172	143	121
5000	2360	913	451	264	172	143	121
5500	2466	929	455	265	173	143	121
6000	2562	942	458	267	173	144	121
6500	2649	953	461	267	174	144	121
7000	2728	963	463	268	174	144	122
7500	2801	972	465	269	174	144	122
8000	2868	980	467	270	174	145	122
8500	2930	987	469	270	175	145	122
9000	2987	994	470	271	175	145	122

Source: See first page of Table A.1

TABLE A.5

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 5%

CONFIDENCE LEVEL 90%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS						
	1.00	1.50	2.00	2.50	3.00	3.50	4.00
50	48	45	43	40	37	33	30
100	92	85	76	67	58	51	44
150	134	118	102	86	73	61	52
200	173	148	123	101	83	68	57
250	209	173	140	112	90	73	60
300	243	196	155	122	96	77	63
350	275	217	167	129	101	80	65
400	305	235	178	135	105	83	66
450	333	251	187	141	108	85	68
500	359	266	195	145	111	86	69
550	385	280	202	149	113	88	70
600	409	292	209	153	115	89	70
650	431	304	215	156	117	90	71
700	453	314	220	158	118	91	72
750	473	324	224	161	119	92	72
800	493	333	229	163	121	92	73
850	511	341	233	165	122	93	73
900	529	349	236	167	123	93	73
950	546	356	240	169	124	94	74
1000	562	363	243	170	124	94	74
1100	592	376	248	173	126	95	74
1200	620	387	253	175	127	96	75
1300	646	396	257	177	128	97	75
1400	670	405	261	179	129	97	75
1500	692	413	264	180	130	98	76
1600	712	420	267	182	131	98	76
1700	731	427	270	183	131	98	76
1800	749	433	272	184	132	99	76
1900	766	439	274	185	132	99	77
2000	782	444	276	186	133	99	77
2250	818	455	281	188	134	100	77
2500	848	465	284	190	135	100	77
2750	875	473	287	191	135	101	78
3000	899	479	290	192	136	101	78
3250	921	485	292	193	136	101	78
3500	940	491	294	194	137	101	78
3750	957	495	295	194	137	102	78
4000	972	499	297	195	137	102	78
4250	986	503	298	196	138	102	78
4500	999	506	299	196	138	102	78
4750	1011	509	300	197	138	102	78
5000	1022	512	301	197	138	102	79
5500	1041	517	303	198	139	102	79
6000	1058	521	305	198	139	103	79
6500	1073	525	306	199	139	103	79
7000	1085	528	307	199	139	103	79
7500	1097	530	308	200	140	103	79
8000	1107	533	308	200	140	103	79
8500	1116	535	309	200	140	103	79
9000	1124	537	310	201	140	103	79

Source: See first page of Table A.1

TABLE A.6

SAMPLE SIZES FOR ATTRIBUTES SAMPLING

EXPECTED ERROR RATE NOT OVER 5%

CONFIDENCE LEVEL 95%

POPULATION SIZE	SAMPLE SIZE FOR PRECISION PERCENTAGE OF PLUS OR MINUS						
	1.00	1.50	2.00	2.50	3.00	3.50	4.00
50	48	47	45	42	40	37	34
100	94	89	82	74	66	59	53
150	138	126	112	99	86	74	64
200	180	160	139	118	100	85	72
250	219	191	161	134	111	93	78
300	257	218	180	147	120	99	82
350	293	244	198	159	128	104	86
400	328	267	213	168	134	108	88
450	360	289	226	177	139	111	90
500	392	309	238	184	144	114	92
550	422	327	249	190	148	117	94
600	451	344	259	196	151	119	95
650	479	360	268	201	154	121	97
700	505	375	276	206	157	122	98
750	531	389	283	210	159	124	98
800	556	402	290	213	161	125	99
850	579	415	296	217	163	126	100
900	602	426	302	220	165	127	101
950	624	437	308	223	167	128	101
1000	645	447	313	225	168	129	102
1100	686	466	322	230	171	131	103
1200	723	483	330	234	173	132	104
1300	759	499	337	238	175	133	104
1400	792	513	344	241	177	134	105
1500	823	526	349	244	178	135	105
1600	852	538	354	246	179	136	106
1700	880	549	359	249	181	136	106
1800	906	559	363	251	182	137	107
1900	930	568	367	253	183	138	107
2000	954	577	371	254	184	138	107
2250	1007	596	379	258	185	139	108
2500	1054	612	385	261	187	140	109
2750	1096	626	391	263	188	141	109
3000	1134	638	395	266	189	141	109
3250	1168	649	400	267	190	142	110
3500	1199	658	403	269	191	142	110
3750	1227	666	406	270	192	143	110
4000	1253	674	409	272	192	143	110
4250	1276	681	411	273	193	143	111
4500	1298	687	414	274	194	144	111
4750	1318	692	416	275	194	144	111
5000	1336	697	418	275	194	144	111
5500	1370	706	421	277	195	145	111
6000	1399	714	423	278	196	145	111
6500	1424	721	426	279	196	145	112
7000	1447	726	428	280	197	145	112
7500	1467	731	430	281	197	146	112
8000	1485	736	431	281	197	146	112
8500	1502	740	432	282	198	146	112
9000	1517	743	434	282	198	146	112

Source: See first page of Table A.1

TABLE F.1

REVISED PRECISION LIMITS

BASED ON ERROR RATE FOUND IN SAMPLE

SAMPLE ERROR RATE - 2%

Sample size	Universe Size of 500 Lower limit	500 Upper limit	1,000 Lower limit	1,000 Upper limit	2,000 Lower limit	2,000 Upper limit	10,000 Lower limit	10,000 Upper limit	50,000 + Lower limit	50,000 + Upper limit
					Confidence Level - 90%					
50	.2%	8.9%	.2%	9.1%	.1%	9.2%	.1%	9.3%	.1%	9.3%
80	.4	6.6	.4	6.8	.3	6.9	.3	7.0	.3	7.0
90	.5	6.1	.4	6.4	.4	6.5	.3	6.6	.3	6.6
100	.5	5.8	.4	6.0	.4	6.1	.4	6.2	.4	6.2
120	.7	5.2	.6	5.5	.5	5.6	.5	5.7	.5	5.7
140	.8	4.8	.6	5.1	.6	5.2	.5	5.3	.5	5.3
150	.8	4.6	.7	4.9	.6	5.0	.6	5.1	.6	5.1
160	.8	4.5	.7	4.8	.7	4.9	.6	5.0	.6	5.0
180	.9	4.3	.8	4.6	.7	4.7	.7	4.8	.7	4.8
200	1.0	4.0	.8	4.3	.8	4.4	.7	4.5	.7	4.5
250	1.2	3.7	1.0	4.0	.9	4.2	.9	4.3	.9	4.3
300			1.2	3.5	1.1	3.7	1.0	3.8	1.0	3.8
400			1.3	3..	1.2	3 4	1.1	3.5	1.1	3.5
500			1.4	2.9	1.3	3.2	1.2	3.3	1.2	3.3
600					1.4	3.0	1.3	3.1	1.3	3.2
700					1.4	2.9	1.3	3.0	1.3	3.1
800					1.5	2.8	1.4	2.9	1.4	3.0
900					1.5	2.7	1.4	2.9	1.4	2.9
1,000					1.6	2.6	1.4	2.8	1.4	2.8
					Confidence Level - 95%					
50	.2%	10.2%	.1%	10.4%	.1%	10.6%	.1%	10.6%	.1%	10.7%
80	.3	7.5	.3	7.7	.2	7.8	.2	7.9	.2	8.0
90	.4	6.9	.3	7.2	.3	7.3	.2	7.4	.2	7.4
100	.4	6.5	.3	6.8	.3	6.9	.3	7.0	.2	7.0
120	.5	5.8	.4	6.1	.4	6.3	.3	6.4	.3	6.4
140	.6	5.4	.5	5.7	.4	5.8	.4	6.0	.4	6.0
150	.7	5.1	.5	5.4	.5	5.6	.4	5.7	.4	5.7
160	.7	5.0	.6	5.3	.5	5.5	.5	5.6	.5	5.6
180	.8	4.7	.7	5.1	.6	5.2	.5	5.3	.5	5.4
200	.9	4.4	.7	4.7	.6	4.9	.6	5.0	.6	5.0
250	1.1	4.0	.9	4.4	.8	4.6	.7	4.8	.7	4.8
300			1.1	3.8	1.0	4.0	.9	4.2	.9	4.2
400			1.2	3.4	1.1	3.6	1.0	3.8	1.0	3.8
500					1.2	3.4	1.1	3.5	1.1	3.6
600					1.3	3.2	1.2	3.3	1.1	3.4
700					1.3	3.0	1.2	3.2	1.2	3.3
800					1.4	2.9	1.3	3.1	1.2	3.2
900					1.5	2.8	1.3	3.0	1.3	3.1
1,000							1.3	3.0	1.3	3.0

Source: Adapted from "Handbook of Sampling for Auditing and Accounting" by Dr. Herbert Arkin, with permission of McGraw-Hill Book Company. Copyright© 1963 by McGraw-Hill, Inc. Arkin's Table F, beginning on page 427 of his book, shows precision limits for other error rates and universe sizes.

Table F.2

REVISED PRECISION LIMITS
BASED ON ERROR RATE FOUND IN SAMPLE

SAMPLE ERROR RATE - 3%

Sample size	Universe Size of 500 Lower limit	500 Upper limit	1,000 Lower limit	1,000 Upper limit	2,000 Lower limit	2,000 Upper limit	10,000 Lower limit	10,000 Upper limit	50,000 + Lower limit	50,000 + Upper limit
Confidence Level - 90%										
80	.9%	8.0%	.8%	8.2%	.7%	8.3%	.7%	8.4%	.7%	8.4%
90	1.0	7.5	.9	7.8	.8	7.9	.8	8.0	.8	8.0
100	1.0	7.2	.9	7.4	.9	7.5	.8	7.6	.8	7.6
120	1.2	6.5	1.1	6.8	1.0	6.9	1.0	7.0	1.0	7.0
140	1.4	6.1	1.2	6.4	1.2	6.6	1.1	6.7	1.1	6.7
150	1.4	5.9	1.3	6.2	1.2	6.4	1.1	6.5	1.1	6.5
160	1.5	5.8	1.3	6.1	1.3	6.3	1.2	6.4	1.2	6.4
180	1.6	5.5	1.4	5.9	1.4	6.0	1.3	6.2	1.3	6.2
200	1.7	5.2	1.5	5.6	1.4	5.7	1.4	5.8	1.3	5.9
250	2.0	4.9	1.7	5.3	1.6	5.5	1.6	5.6	1.5	5.7
300			1.9	4.8	1.8	4.9	1.7	5.1	1.7	5.1
400			2.1	4.4	2.0	4.6	1.9	4.7	1.9	4.7
500			2.3	4.1	2.1	4.3	2.0	4.5	2.0	4.5
600					2.2	4.1	2.1	4.3	2.1	4.3
700					2.3	4.0	2.2	4.2	2.1	4.2
800					2.4	3.9	2.2	4.1	2.2	4.1
900					2.4	3.8	2.2	4.0	2.2	4.0
1,000					2.5	3.7	2.3	3.9	2.3	4.0
Confidence Level - 95%										
80	.7%	8.9%	.6%	9.2%	.6%	9.3%	.5%	9.5%	.5%	9.5%
90	.8	8.4	.7	8.7	.6	8.8	.6	8.9	.6	8.9
100	.9	8.0	.7	8.3	.7	8.4	.6	8.5	.6	8.5
120	1.0	7.2	.9	7.5	.8	7.6	.8	7.8	.8	7.8
140	1.2	6.7	1.0	7.1	.9	7.3	.9	7.4	.9	7.4
150	1.3	6.5	1.1	6.8	1.0	7.0	.9	7.1	.9	7.1
160	1.3	6.4	1.1	6.7	1.1	6.9	1.0	7.0	1.0	7.1
180	1.4	6.0	1.2	6.4	1.1	6.6	1.1	6.8	1.1	6.8
200	1.5	5.7	1.3	6.1	1.2	6.2	1.1	6.4	1.1	6.4
250	1.8	5.2	1.5	5.8	1.4	6.0	1.3	6.1	1.3	6.2
300			1.8	5.1	1.6	5.3	1.5	5.5	1.5	5.5
400			1.9	4.7	1.7	4.9	1.6	5.1	1.6	5.2
500					2.0	4.6	1.8	4.8	1.8	4.8
600					2.1	4.3	1.9	4.6	1.9	4.6
700					2.1	4.2	2.0	4.4	2.0	4.5
800					2.2	4.0	2.1	4.3	2.0	4.3
900					2.3	3.9	2.1	4.2	2.1	4.2
1,000							2.2	4.1	2.1	4.2

Source: See Table F.1

TABLE F.3
REVISED PRECISION LIMITS
BASED ON ERROR RATE FOUND IN SAMPLE

SAMPLE ERROR RATE - 5%

Sample size	Universe Size of 500 Lower limit	500 Upper limit	1,000 Lower limit	1,000 Upper limit	2,000 Lower limit	2,000 Upper limit	10,000 Lower limit	10,000 Upper limit	50,000 + Lower limit	50,000 + Upper limit
Confidence Level - 90%										
80	2.0%	10.6%	1.8%	10.9%	1.8%	11.0%	1.7%	11.1%	1.7%	11.1%
90	2.2	10.1	2.0	10.4	1.9	10.5	1.9	10.6	1.9	10.7
100	2.3	9.7	2.1	10.0	2.1	10.1	2.0	10.3	2.0	10.3
120	2.6	9.1	2.4	9.4	2.3	9.5	2.2	9.6	2.2	9.7
140	2.8	8.7	2.6	9.0	2.5	9.2	2.4	9.3	2.4	9.3
150	2.9	8.4	2.7	8.7	2.6	8.9	2.5	9.0	2.5	9.0
160	3.0	8.2	2.7	8.5	2.6	8.7	2.5	8.8	2.5	8.9
180	3.1	7.9	2.9	8.3	2.8	8.4	2.7	8.6	2.7	8.6
200	3.3	7.6	3.0	8.0	2.9	8.2	2.8	8.3	2.8	8.4
250	3.6	7.1	3.3	7.5	3.1	7.7	3.0	7.9	3.0	7.9
300			3.4	7.2	3.3	7.4	3.2	7.6	3.2	7.6
400			3.7	6.7	3.5	7.0	3.4	7.2	3.4	7.2
500			4.0	6.4	3.7	6.7	3.6	6.9	3.5	6.9
600					3.9	6.4	3.7	6.7	3.7	6.7
700					4.0	6.3	3.8	6.5	3.8	6.6
800					4.1	6.1	3.9	6.4	3.8	6.5
900					4.2	6.0	3.9	6.3	3.9	6.4
1,000					4.2	5.9	4.0	6.2	3.9	6.3
Confidence Level - 95%										
80	1.7%	11.7%	1.5%	12.0%	1.5%	12.2%	1.4%	12.3%	1.4%	12.3%
90	1.8	11.1	1.7	11.4	1.6	11.6	1.5	11.7	1.5	11.7
100	2.0	10.6	1.8	11.0	1.7	11.1	1.7	11.3	1.6	11.3
120	2.3	9.8	2.1	10.2	2.0	10.4	1.9	10.5	1.9	10.6
140	2.5	9.4	2.3	9.8	2.2	10.0	2.1	10.1	2.1	10.1
150	2.6	9.0	2.3	9.4	2.2	9.6	2.1	9.8	2.1	9.8
160	2.7	8.8	2.4	9.2	2.3	9.4	2.2	9.6	2.2	9.6
180	2.8	8.4	2.6	8.9	2.4	9.1	2.3	9.2	2.3	9.3
200	3.0	8.1	2.7	8.6	2.6	8.8	2.5	9.0	2.4	9.0
250	3.3	7.5	3.0	8.0	2.8	8.3	2.7	8.4	2.7	8.5
300			3.2	7.6	3.0	7.9	2.9	8.1	2.8	8.1
400			3.5	7.0	3.3	7.3	3.1	7.6	3.1	7.6
500					3.5	7.0	3.3	7.2	3.3	7.3
600					3.7	6.7	3.4	7.0	3.4	7.0
700					3.8	6.5	3.6	6.8	3.5	6.9
800					3.9	6.4	3.7	6.7	3.6	6.7
900					4.0	6.2	3.7	6.6	3.7	6.6
1,000							3.8	6.5	3.8	6.5

Source: See Table F.1

TABLE F.4

REVISED PRECISION LIMITS
BASED ON ERROR RATE FOUND IN SAMPLE

SAMPLE ERROR RATE - 10%

Sample size	Universe Size of 500 Lower limit	500 Upper limit	1,000 Lower limit	1,000 Upper limit	2,000 Lower limit	2,000 Upper limit	10,000 Lower limit	10,000 Upper limit	50,000 + Lower limit	50,000 + Upper limit
					Confidence Level - 90%					
50	4.3%	19.4%	4.2%	19.7%	4.1%	19.8%	4.0%	19.8%	4.0%	19.9%
80	5.5	16.7	5.3	17.1	5.2	17.2	5.1	17.3	5.1	17.3
90	5.8	16.2	5.6	16.5	5.5	16.7	5.4	16.8	5.4	16.8
100	6.0	15.7	5.8	16.1	5.6	16.2	5.6	16.4	5.5	16.4
120	6.4	15.0	6.1	15.4	6.0	15.5	5.9	15.7	5.9	15.7
140	6.8	14.4	6.4	14.8	6.3	15.0	6.2	15.2	6.2	15.2
150	6.9	14.0	6.6	14.4	6.4	14.6	6.3	14.8	6.3	14.8
160	7.0	14.0	6.7	14.4	6.5	14.6	6.4	14.8	6.4	14.8
180	7.3	13.6	6.9	14.1	6.7	14.3	6.6	14.4	6.6	14.5
200	7.5	13.3	7.1	13.8	6.9	14.0	6.8	14.2	6.8	14.2
250	7.9	12.6	7.5	13.2	7.3	13.5	7.1	13.7	7.1	13.7
300			7.8	12.8	7.5	13.1	7.4	13.3	7.3	13.3
400			8.2	12.2	7.9	12.5	7.7	12.8	7.7	12.8
500			8.5	11.8	8.2	12.2	8.0	12.4	7.9	12.5
600					8.4	11.9	8.1	12.2	8.1	12.2
700					8.6	11.7	8.3	12.0	8.2	12.1
800					8.7	11.5	8.4	11.8	8.3	11.9
900					8.8	11.3	8.5	11.7	8.4	11.8
1,000					8.9	11.2	8.6	11.6	8.5	11.7
					Confidence Level - 95%					
50	3.7%	21.2%	3.5%	21.5%	3.4%	21.7%	3.3%	21.8%	3.3%	21.8%
80	4.9	18.0	4.6	18.4	4.5	18.6	4.4	18.7	4.4	18.8
90	5.2	17.4	4.9	17.8	4.8	17.9	4.7	18.1	4.7	18.1
100	5.4	16.8	5.2	17.3	5.0	17.4	4.9	17.6	4.9	17.6
120	5.9	15.9	5.6	16.4	5.4	16.6	5.3	16.8	5.3	16.8
140	6.2	15.3	5.9	15.8	5.7	16.0	5.6	16.2	5.6	16.2
150	6.4	15.0	6.0	15.5	5.9	15.7	5.7	15.9	5.7	15.9
160	6.6	14.7	6.2	15.3	6.0	15.5	5.9	15.7	5.8	15.7
180	6.8	14.3	6.4	14.8	6.2	15.1	6.1	15.3	6.0	15.3
200	7.1	13.9	6.6	14.5	6.4	14.8	6.3	15.0	6.2	15.0
250	7.6	13.1	7.0	13.8	6.8	14.1	6.6	14.4	6.6	14.4
300			7.4	13.3	7.1	13.7	6.9	13.9	6.9	14.0
400			7.9	12.6	7.5	13.0	7.3	13.3	7.3	13.4
500					7.9	12.6	7.6	12.9	7.5	13.0
600					8.1	12.2	7.8	12.6	7.7	12.7
700					8.3	12.0	8.0	12.4	7.9	12.5
800					8.5	11.8	8.1	12.2	8.0	12.3
900					8.6	11.6	8.2	12.1	8.1	12.1
1,000							8.3	11.9	8.2	12.0

Source: See Table F.1

TABLE F.5

REVISED PRECISION LIMITS
BASED ON ERROR RATE FOUND IN SAMPLE

SAMPLE ERROR RATE - 15%

Sample size	Universe Size of 500 Lower limit	500 Upper limit	1,000 Lower limit	1,000 Upper limit	2,000 Lower limit	2,000 Upper limit	10,000 Lower limit	10,000 Upper limit	50,000 + Lower limit	50,000 + Upper limit
Confidence Level - 90%										
50	7.9%	25.3%	7.7%	25.6%	7.6%	25.7%	7.5%	25.8%	7.5%	25.9%
80	9.4	22.5	9.1	22.8	9.0	23.0	8.9	23.1	8.9	23.2
90	9.7	21.9	9.3	22.3	9.3	22.6	9.2	22.6	9.2	22.6
100	10.1	21.4	9.8	21.8	9.6	22.0	9.5	22.1	9.5	22.2
120	10.6	20.6	10.2	21.0	10.1	21.2	10.0	21.4	9.9	21.4
140	11.0	20.0	10.6	20.5	10.5	20.7	10.3	20.8	10.3	20.9
150	11.2	19.7	10.8	20.2	10.6	20.4	10.5	20.6	10.5	20.6
160	11.4	19.5	11.0	20.0	10.8	20.2	10.6	20.4	10.6	20.4
180	11.7	19.1	11.2	19.6	11.0	19.9	10.8	20.0	10.8	20.1
200	11.9	18.7	11.5	19.3	11.2	19.6	11.1	19.8	11.1	19.8
250	12.5	18.0	11.9	18.7	11.7	19.0	11.5	19.2	11.5	19.2
300			12.3	18.2	12.0	18.5	11.8	18.8	11.8	18.8
400			12.8	17.5	12.5	17.9	12.2	18.2	12.2	18.2
500			13.2	17.0	12.8	17.5	12.5	17.8	12.5	17.9
600					13.1	17.2	12.8	17.5	12.7	17.6
700					13.3	16.9	12.9	17.3	12.9	17.4
800					13.4	16.7	13.1	17.1	13.0	17.2
900					13.6	16.6	13.2	17.0	13.1	17.1
1,000					13.7	16.4	13.3	16.9	13.2	17.0
Confidence Level - 95%										
80	8.6%	23.9%	8.3%	24.3%	8.1%	24.5%	8.0%	24.7%	8.0%	24.7%
90	9.0	23.2	8.7	23.7	8.5	23.9	8.4	24.0	8.4	24.1
100	9.3	22.6	9.0	23.1	8.8	23.3	8.7	23.5	8.7	23.5
120	9.9	21.7	9.5	22.2	9.3	22.4	9.2	22.6	9.1	22.7
140	10.4	20.9	9.9	21.5	9.7	21.8	9.6	22.0	9.5	22.0
150	10.6	20.6	10.1	21.2	9.9	21.5	9.7	21.7	9.7	21.7
160	10.8	20.4	10.3	20.9	10.1	21.2	9.9	21.6	9.9	21.5
180	11.0	19.9	10.6	20.5	10.3	20.8	10.2	21.0	10.1	21.1
200	11.4	19.4	10.9	20.1	10.6	20.4	10.4	20.7	10.4	20.7
250	12.0	18.6	11.4	19.4	11.1	19.7	10.9	20.0	10.8	20.0
300			11.8	18.8	11.5	19.2	11.2	19.5	11.2	19.5
400			12.4	18.0	12.0	18.5	11.7	18.8	11.7	18.9
500					12.4	18.0	12.1	18.4	12.0	18.4
600					12.7	17.6	12.3	18.0	12.3	18.1
700					12.9	17.3	12.5	17.8	12.5	17.8
800					13.1	17.1	12.7	17.6	12.6	17.6
900					13.3	16.9	12.8	17.4	12.8	17.5
1,000							13.0	17.3	12.9	17.4

Source: See Table F.1

REVISED PRECISION LIMITS
BASED ON ERROR RATE FOUND IN SAMPLE

TABLE F.6

SAMPLE ERROR RATE - 0%

Sample size	Universe Size of 500 Upper limit	1,000 Upper limit	2,000 Upper limit	10,000 Upper limit	50,000 + Upper limit
			Confidence Level - 90%		
30	7.2%	7.3%	7.3%	7.4%	7.4%
40	5.4	5.5	5.5	5.6	5.6
50	4.3	4.4	4.4	4.5	4.5
60	3.5	3.7	3.7	3.8	3.8
70	3.0	3.1	3.2	3.2	3.2
80	2.6	2.7	2.8	2.8	2.8
90	2.3	2.4	2.5	2.5	2.5
100	2.0	2.2	2.2	2.3	2.3
150	1.3	1.4	1.5	1.5	1.5
200	.9	1.0	1.1	1.1	1.1
300		.6	.7	.7	.8
400		.4	.5	.6	.6
500		.3	.4	.5	.5
1,000			.2	.2	.2
			Confidence Level - 95%		
30	9.2%	9.4%	9.4%	9.5%	9.5%
40	6.9	7.1	7.1	7.2	7.2
50	5.5	5.7	5.7	5.8	5.8
60	4.6	4.7	4.8	4.9	4.9
70	3.9	4.0	4.1	4.2	4.2
80	3.4	3.5	3.6	3.7	3.7
90	3.0	3.1	3.2	3.3	3.3
100	2.6	2.8	2.9	2.9	3.0
150	1.7	1.8	1.9	2.0	2.0
200	1.2	1.3	1.4	1.5	1.5
300		.8	.9	1.0	1.0
400		.6	.7	.7	.7
500			.5	.6	.6
1,000				.3	.3

Source: See Table F.1

THREE MAJOR ACTIVITIES IN ANALYSIS PHASE

- Organizing Data
- Analyzing Data
- Developing Proposals or Recommendations

ANALYSIS

A. ORGANIZE

A. SPREAD SHEETS
B. TABLE OF FIGURES
C. INTERVIEW FORMS
D. ORGANIZATION CHART
E. PROCESS CHART
F. LAYOUT ANALYSIS

B. ANALYZE

1. VERIFY DISCREPANCIES
2. COMPLETE OMISSIONS
3. EXAMINATION
4. ARRIVE AT CONCLUSIONS AND TENTATIVE RECOMMENDATIONS
5. TEST COMPLEX RECOMMENDATIONS
6. DISCUSS CONCLUSIONS AND RECOMMENDATIONS WITH MANAGEMENT

C. DEVELOP PROPOSALS AND RECOMMENDATIONS

PRINCIPLES FOR ORGANIZING FACTS

- Facts Should be Recorded in Such a Way That Related Items of Information can be Easily Brought Together and Coordinated.

- Verify and Correct Discrepancies or Omissions in Collected Facts.

- Facts Should be Organized in the Simplest Manner Possible, Consistent with Completeness (Do not use Complicated Charts if Simple Notes will Serve).

PRINCIPLES FOR ORGANIZING FACTS (Cont'd)

- Facts Should be Organized in Such a Way That They can be Understood by Someone Who is Not a Part of the Review Team.

- The Information Should be Classified in Such a Way That It can be Found Easily.

PRINCIPLES OF ANALYSIS

- Examine and Compare the Actual Situation with the Ideal. Identify and Measure Those Areas Which Differ Significantly.
- Analyze These Discrepancies to Determine Cause and Corrective Action.
- Arrive at Conclusions and Tentative Recommendations.
- Evaluate Alternative Recommendations in Light of Criteria and Constraints.
- Test Complex Recommendations (Pilot Project and/or Trial Basis).

Note: Review study plan and criteria established. These are the yardsticks used to determine degree of difference between actual and ideal situation.

CRITICAL EXAMINATION CHALLENGES

EVERY SEGMENT OF THE OPERATION

AS TO

Purpose:	**What** IS ACTUALLY DONE AND IS IT NECESSARY?	**Eliminate** UNNECESSARY PARTS OF THE JOB
	Why IS THE ACTIVITY NECESSARY AT ALL?	
Place:	**Where** IS IT DONE? NEED IT BE DONE AT THAT PARTICULAR PLACE?	**Combine** WHEREVER POSSIBLE
Sequence:	**When** IS IT DONE? NEED IT BE DONE AT THAT PARTICULAR TIME?	OR
Person:	**Who** IS DOING IT? COULD IT BE DONE BETTER BY SOMEONE ELSE?	**Rearrange**
Means:	**How** IS IT BEING DONE? IS THERE ANY POSSIBILITY OF DOING IT MORE ECONOMICALLY IN SOME OTHER WAY?	**Simplify** THE OPERATION

IDENTIFY THE PROBLEM, NOT THE SYMPTOMS

- WHAT IS IT?
- WHERE IS THE PROBLEM?
- WHEN DOES IT OCCUR?
- WHO DOES IT AFFECT?
- WHAT FACTORS NEED EMPHASIS?

STATE THE PROBLEM IN WRITING

UNDERLYING CAUSE

SOME EXAMPLES OF CAUSE:

(A) LACK OF TRAINING;

(B) LACK OF COMMUNICATION;

(C) UNFAMILIARITY WITH REQUIREMENTS;

(D) NEGLIGENCE OR CARELESSNESS;

(E) GUIDELINES OR STANDARDS (CRITERIA) ARE INADEQUATE, NOT PROVIDED, OBSOLETE, OR IMPRACTICAL;

(F) CONSCIOUS DECISION OR INSTRUCTION TO DEVIATE FROM REQUIREMENTS (FOR ANY OF A VARIETY OF REASONS);

(G) LACK OF RESOURCES (FUNDS OR STAFF);

(H) FAILURE TO USE GOOD JUDGEMENT OR COMMON SENSE;

(I) DISHONESTY;

(J) LACK OF EFFECTIVE OR SUFFICIENT SUPERVISION, OR LACK OF SUPERVISORY REVIEW;

(K) UNWILLINGNESS TO CHANGE; AND

(L) LACK OF PLANNING, FAULTY OR INEFFECTIVE ORGANIZATIONAL ARRANGEMENT, OR DELEGATIONS OF AUTHORITY.

TYPICAL EFFECTS

SOME EXAMPLES OF EFFECTS ARE:

(A) UNECONOMICAL OR INEFFICIENT USE OF RESOURCES (TIME, MONEY, MANPOWER);

(B) LOSS OF POTENTIAL INCOME OR FEDERAL PARTICIPATION;

(C) VIOLATION OF LAW;

(D) FUNDS IMPROPERLY SPENT;

(E) INFORMATION OR RECORDS WHICH ARE MEANINGLESS OR INACCURATE;

(F) INEFFECTIVENESS - THE JOB NOT BEING ACCOMPLISHED AS WELL AS IT COULD BE OR AS INTENDED;

(G) INADEQUATE CONTROL OR LOSS OF CONTROL OVER RESOURCES OR ACTIONS;

(H) LACK OF ASSURANCE THAT THE JOB IS BEING DONE PROPERLY; AND

(I) LACK OF ASSURANCE THAT OBJECTIVES ARE BEING MET.

CHARACTERISTICS OF EFFECTIVE RECOMMENDATIONS

- CONSTRUCTIVE IN NATURE
- ADDRESS A SPECIFIC PROBLEM OR ASPECT OF THE PROBLEM
- PROPOSE SPECIFIC ACTIONS TO BE TAKEN
- IDENTIFY WHO SHOULD TAKE THE ACTIONS(S)
- ARE CONSISTENT WITH AND SUPPORTIVE OF OTHER RECOMMENDED ACTIONS
- ARE REALISTIC AND LOGICALLY SUPPORTABLE
- INCLUDE DRAFT IMPLEMENTING DOCUMENTS (I.E., NEW OR REVISED LETTERS, PROCEDURES, DELEGATIONS, FORMS, ETC.)

FUNCTIONS OF A REPORT

1. TO PROVIDE APPROPRIATE MANAGEMENT OFFICIALS WITH INFORMATION AND DECISION OPTIONS ON THE REVIEW AREA.

2. TO PROVIDE THE ORGANIZATION REVIEWED WITH A FORMAL DOCUMENT UPON WHICH TO BASE ITS PROGRAM FOR ACTING UPON THE REVIEW.

3. TO PROVIDE THE ORGANIZATION AND REVIEWER WITH A DOCUMENT FOR FOLLOWING UP TO SEE THAT:
   - ACCEPTED RECOMMENDATIONS ARE PROPERLY AND PROMPTLY INSTALLED AND,
   - FOR LATER EVALUATION OF ACTUAL BENEFITS DERIVED FROM THEIR INSTALLATION.

4. TO ACQUAINT OFFICIALS WITH PROBLEMS UNCOVERED BUT NOT WITHIN THE SCOPE OF THE REVIEW, WHICH SHOULD RECEIVE THE ATTENTION OF THE ORGANIZATION.

5. TO INFORM OFFICIALS OF RECOMMENDATIONS THAT HAVE BEEN ACCEPTED AND PUT INTO EFFECT BY THE ORGANIZATION DURING THE COURSE OF THE REVIEW.

6. TO DISTRIBUTE AND PLACE ON REFERENCE A SUMMARIZED REPORT OF REVIEW FINDINGS AND RESULTS FOR USE IN OTHER ACTIVITIES (I.E., FUTURE REVIEWS IN THE SAME FIELD, ETC.).

OUTLINE FOR

FORMAL WRITTEN REPORTS

I INTRODUCTION

- A. BACKGROUND
- B. REVIEW OBJECTIVES
- C. REVIEW APPROACH

II SUMMARY OF RECOMMENDATIONS

(EXECUTIVE SUMMARY)

III DETAILED FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

- A. FINDINGS
- B. CONCLUSIONS
- C. RECOMMENDATIONS
  1. RECOMMENDATION NUMBER 1 (RELATES TO FIRST FINDING AND FIRST CONCLUSION)
  2. RECOMMENDATION NUMBER 2
  3. ETC.

IV IMPLEMENTATION PLAN

GENERAL CHARACTERISTICS OF FINDINGS

1. EVALUATE THE SIGNIFICANCE OF WHAT YOU ARE REPORTING. THIS IS NECESSARY TO COME UP WITH MEANINGFUL AND SPECIFIC RECOMMENDATIONS.

2. WRITE IN SIMPLE, NONTECHNICAL AND CLEAR LANGUAGE.

3. IF YOU REFER TO A FORM NUMBER, STATE ITS NAME OR SUBJECT SOMEWHERE IN THE REPORT.

4. IF YOU USE ABBREVIATIONS, SPELL OUT THEIR MEANING WHEN THEY FIRST APPEAR.

5. ACCURACY OF FACTS AND REASONABLENESS OF LOGIC IS MOST IMPORTANT.

6. BE OBJECTIVE AND INCLUDE ALL SIGNIFICANT, RELEVANT INFORMATION.

7. BE CONCISE. AVOID WORDINESS AND INCLUSION OF EXTRANEOUS MATTER.

8. DO NOT BE EVASIVE. IF YOU HAVE SOMETHING TO SAY AND CAN SUPPORT IT, THEN SAY IT.

9. WRITE CONSTRUCTIVELY. AVOID DISAGREEABLE TONE, SARCASM, RIDICULE, OR ORATORY. STRESS THE NEED FOR IMPROVEMENTS IN THE FUTURE RATHER THAN HARPING ON DEFICIENCIES IN THE PAST.

[CONTINUED]

10. ALL CONCLUSIONS MUST BE ADEQUATELY SUPPORTED BY FINDINGS.

11. PRESENT RELEVANT COMMENTS AND VIEWS OF THE MANAGEMENT STAFF ON THE ISSUES BEING DISCUSSED.

12. DON'T GENERALIZE (I.E., SIMPLY SAYING THAT A PRACTICE "WEAKENS CONTROLS." YOU SHOULD STATE HOW AND WHERE IT WEAKENS CONTROLS).

SUGGESTED ORDER FOR PREPARATION & PRESENTATION OF FINDINGS

- Heading - Should be fairly brief. Should identify the nature of the finding. Should not be written in language which has an overly critical tone, but should clearly indicate what was found wrong.

  One way to avoid sounding overly critical is to use constructive language in the captions, e.g.: "Need for improvements in _____"; "Controls over _____ need strengthening", etc. At times, a more pointed caption might be in order, e.g.: "Inspectors are not testing materials."

- Opening Paragraph - Statement of Condition - In this section you should set the scene or circumstances surrounding the finding, and present in a logical sequence, the facts and specific illustrations describing the condition. Each statement of condition must contain sufficient qualitative and quantitative evidence to fully support the conclusions or main point. The statement of condition should be brief but not to the point where completeness is sacrificed.

- Criteria - The criteria represents the standard which is used in measuring a questionable condition or behavior. Published criteria may be directly quoted, summarized or paraphrased, depending on its

length, relevance and clarity. If common sense or subjective judgement is used as criteria, they should be both logical and convincing to the reader.

- Cause - The cause is the underlying reason why the questionable behavior or condition occurred. This sensitive and usually highly judgemental area requires the most penetrating efforts and insights the reviewer can call upon.

  It is necessary to exert a reasonable amount of effort to get as close to the real cause of the problem as possible, or at least to one or more causes which will put the finding in perspective, make the finding convincing and lead to a sensible, specific recommendation for corrective action. Simply saying that the problem or adverse condition exists because someone didn't comply with regulations is not very meaningful, helpful or convincing. This approach usually confines you to the rather superficial recommendation that they "comply with regulations".

- Effect - Is the actual or potential adverse impact which has resulted or can result from the condition being measured in dollars or other terms (examples of effect discussed under analysis). If you do not present information on the actual or potential adverse effect, the reader might assume that the apparent lack of concern means that the finding is not very important. If the effect is not significant, the the finding should not be included in the report. Caution should be exercised so as not to create an issue larger than the facts actually warrant.

- Discussions with Management - This section of the findings should contain pertinent comments made by responsible management officials in response to the conditions reported and/or recommendations made. In addition to presenting management's concurrence with the finding, opposing viewpoints, if any, should also be presented to provide a sense of balance and objectivity. To the extent practical, the specific action taken or planned by management should be presented.

- Conclusions - Are inferences or judgements reached. The conclusion section is a summation statement to bring the reader back to the major theme and to present the final argument for change. This closing paragraph should state clearly and objectively your conclusions based on the conditions set forth in the findings. Conclusions stated should be as specific as possible, should logically follow from the facts presented and in general should be sound, adequately supported and reasonable.

- Recommendations - Generally, each finding will result in one or more recommendations. Experience indicates a great receptivity to constructive recommendations. Constructive recommendations are dependent on identification of cause.

Some basic guidelines for developing recommendations.

- Present recommendations as a logical sequence to the related statement of conditions.
- Present recommendations that are as specific, realistic and as helpful as possible and are related directly to the cause of the

weakness or deficiency. State what action will provide a meaningful solution to the problems and not simply recommend that "regulations be complied with", "controls be strengthened", or "procedures be established".

- Direct the recommendations toward the reviewed organization and to the specific officials who have responsibility and authority to take corrective action.
- Do not include recommendations on which adequate action has been taken before the report is issued. Instead report in the body of the finding what action has been taken to correct the situation and only present additional recommendations as warranted.
- Avoid use of extreme language in making recommendations, such as "immediately", "expedite", "without delay", "as soon as possible" unless the nature of the problem is so serious that such language seems particularly appropriate.

Material, thoughts, or information which were not developed in the body of the finding should not be introduced in the recommendation. The recommendation should follow logically from what is presented in the finding. In plain words, findings support conclusions and conclusions support the recommendations.

USE AND DESIGN OF CHARTS

1. First Step - Arrangement in Tabular Form.

   a. Systematic arrangement of numerical notes in columns and rows

   b. Purpose: To present quantitive facts:

      (1) Clearly - orderly and organized;

      (2) Concisely - saves space and words;

      (3) Explicitly - document data in text, and charts, and;

      (4) To facilitate understanding of logical relationships.

   c. Analysis of data in table will provide insight as to the kinds of chart which will be most effective for demonstrating the point you want to make.

2. Charts (including Maps) have four uses:

   a. To emphasize the Main Numerical Facts;

   b. To uncover facts that may be overlooked in the text or in a tabular presentation;

   c. To summarize a cumbersome mass of tabular data;

   d. To add variety to text or tabular material, making the report more interesting to look at and easier to read and understand.

3. To use charts effectively you should follow three steps:

   a. Select an appropriate type.

   b. Design to focus the reader's attention on the specific point the chart is to emphasize.

   c. Construct it to be easily read and understood.

4. Selecting the right kind of chart.

   a. What is the point you are trying to make? (A subjective judgment.)

b. What kinds of charts are available? (Choice limited only by imagination. There are curve charts, surface charts, column charts, bar charts and combination charts, many variations on each of these.

c. Components of a chart (See passout from "Statistical Presentation" Department of the Army, ASME.)

5. Check List for Designing Charts

a. Use charts for salient facts only.

b. Limit each chart to one major idea.

c. Adapt the chart type to fit the needs of the data

d. Keep the design simple and uncluttered.

e. Separate unrelated charts; group related ones.

Note: Charts should be used only when they add something important to the report. Do not use them when the story can be told better in text or in a tabular form.

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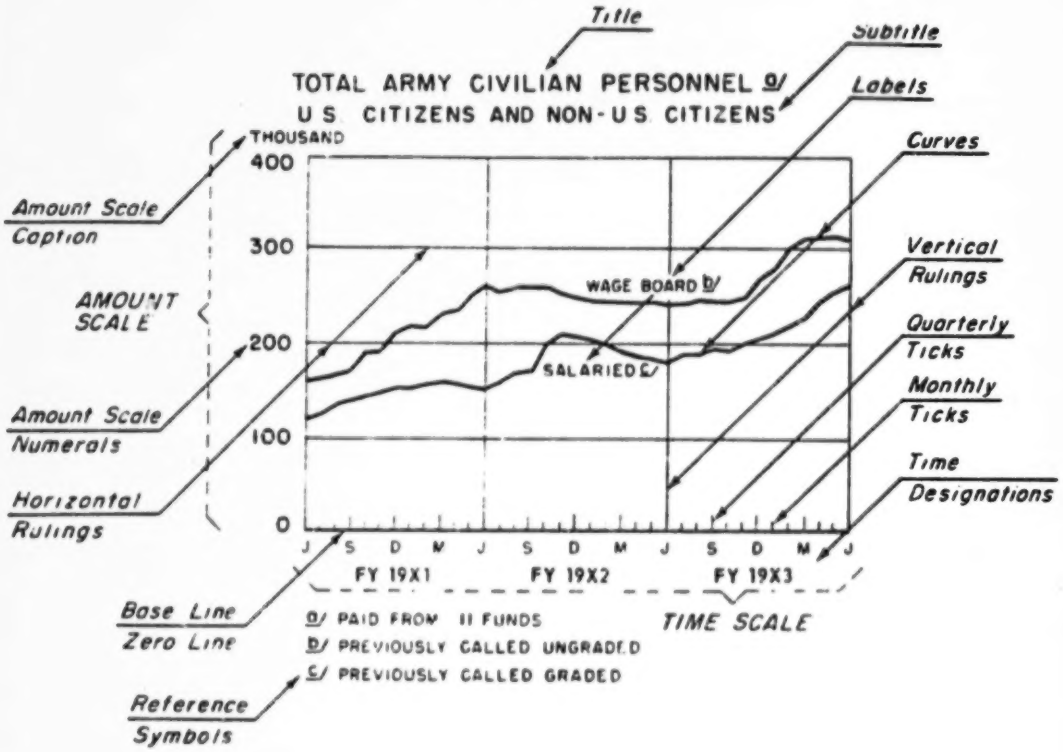
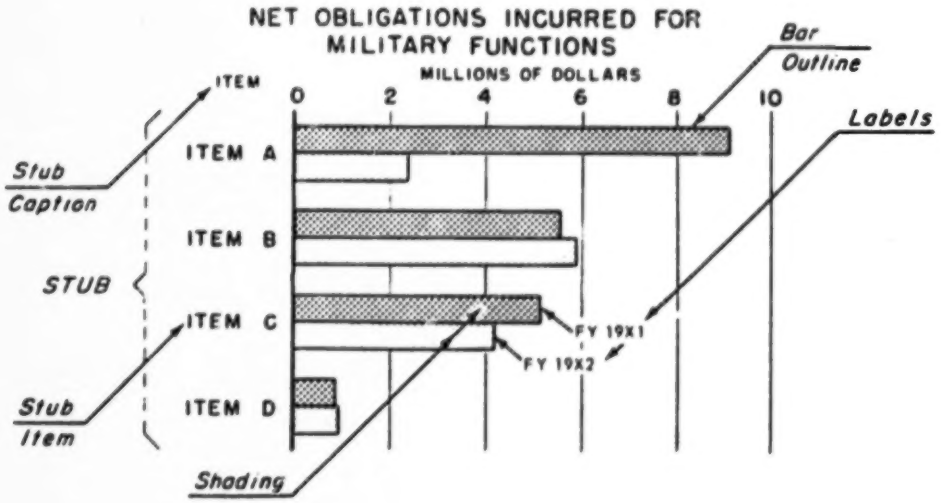
CHART COMPONENTS





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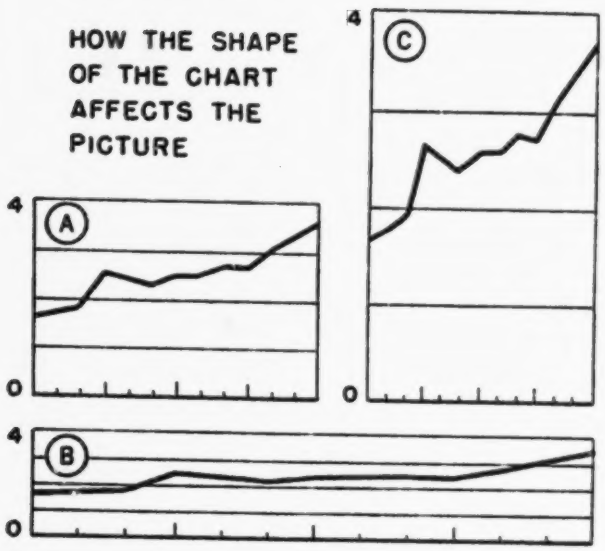
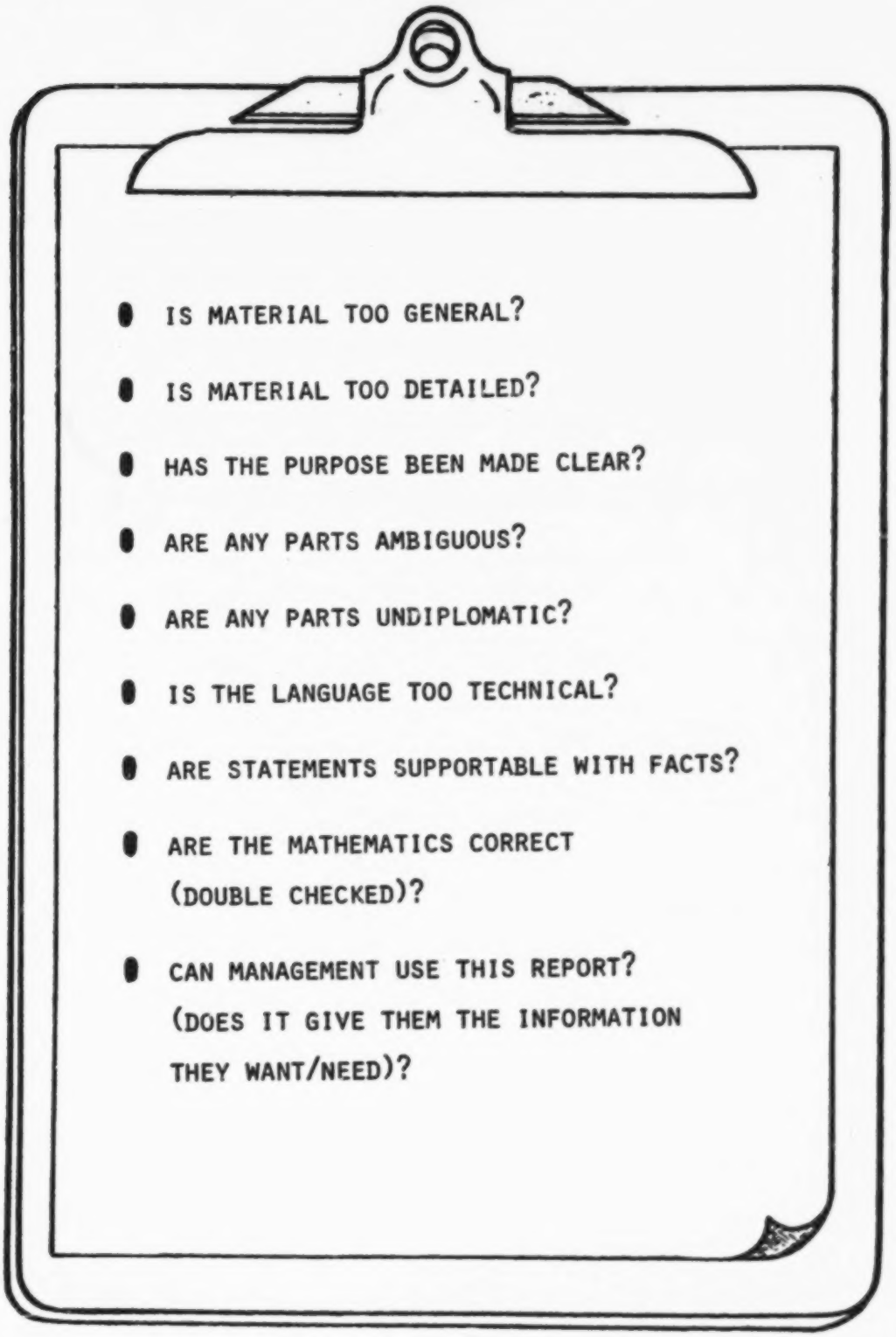


REPORT CHECKLIST



- IS MATERIAL TOO GENERAL?
- IS MATERIAL TOO DETAILED?
- HAS THE PURPOSE BEEN MADE CLEAR?
- ARE ANY PARTS AMBIGUOUS?
- ARE ANY PARTS UNDIPLOMATIC?
- IS THE LANGUAGE TOO TECHNICAL?
- ARE STATEMENTS SUPPORTABLE WITH FACTS?
- ARE THE MATHEMATICS CORRECT (DOUBLE CHECKED)?
- CAN MANAGEMENT USE THIS REPORT? (DOES IT GIVE THEM THE INFORMATION THEY WANT/NEED)?

- <u>SPECIAL PRINCIPLES TO BE FOLLOWED FOR WRITTEN REPORTS.</u>

  - SHOULD BE IN THE STANDARD FORMAT WHENEVER POSSIBLE SHOULD BE SUFFICIENTLY FLEXIBLE TO FIT SPECIAL REQUIREMENTS.

  - SHOULD BE SIMPLE AND AS BRIEF AS POSSIBLE, CONSISTENT WITH COMPLETENESS.

  - TONE SHOULD BE DISPASSIONATE, IMPERSONAL, AND FACTUAL AVOID RED FLAG WORDS.

  - SHOULD HAVE AN ATTRACTIVE APPEARANCE AS POSSIBLE.

  - SHOULD INCLUDE VISUAL AIDS (CHARTS, GRAPHS) WHENEVER THEY WILL PROMOTE BETTER OR EASIER UNDERSTANDING OF THE MATERIAL.

  - RECOMMENDATIONS SHOULD BE SUBMITTED WITH DRAFT DOCUMENTS, INSTRUCTIONS, ANNOUNCEMENTS, ETC. NECESSARY TO MAKE THEM EFFECTIVE.

  - RESULTS SHOULD USUALLY BE REVIEWED VERBALLY WITH MANAGEMENT AFTER WRITTEN REPORT IS SUBMITTED (ORAL PRESENTATION IS OFTEN USED).

CLOSE OUT CONFERENCE

- USUALLY SCHEDULED AFTER DRAFT REPORT SUBMITTED

  - EXPLAIN

    MAJOR ASPECTS OF REPORT

    ANSWER MANAGEMENT'S QUESTIONS

    NOTE CRITICISM, SUGGESTIONS, ETC.

SOME CASES PRE-CLOSE OUT CONFERENCE HELD

- VERY GENERAL DISCUSSION OF WHAT HAS TAKEN PLACE
- YOUR OVERALL OBSERVATIONS

NORMALLY HELD AFTER DATA COLLECTION PHASE

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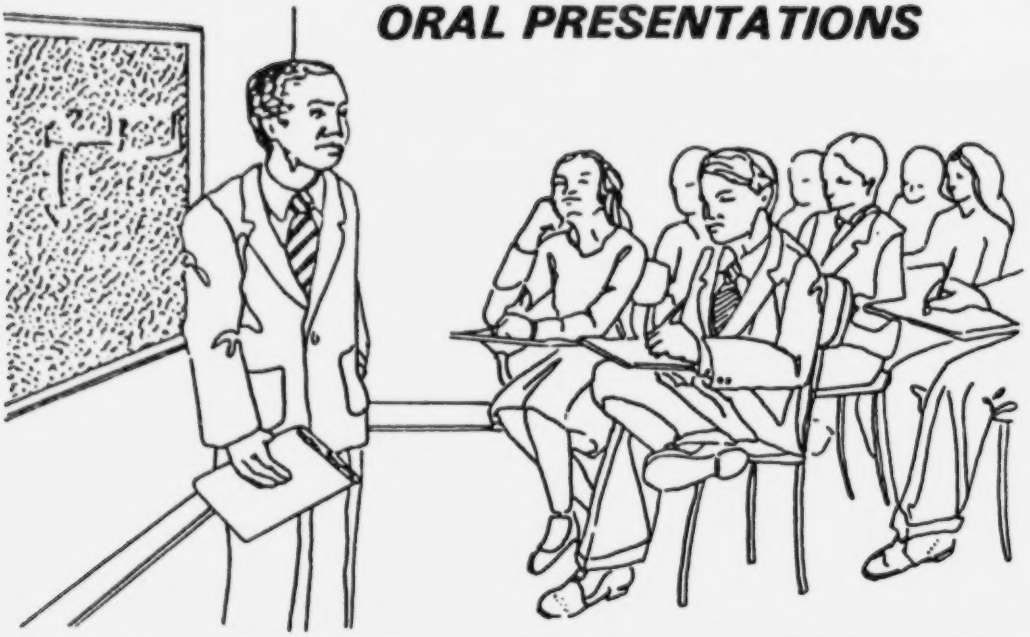
ORAL PRESENTATIONS



Advantages	*Disadvantages*
• Cost Less to Reach More People Use Analyst's Time • Permits Two-Way Communication • Provide Opportunity for Educating, Informing, and Selling • Allows Speaker Flexibility to: — Adjust Presentation — Adjust Pace — Gear Presentation to Audience	• Must be Geared to Multiple Levels of Management and Technical Personnel • Limit Amount of Dialogue and Feedback • Provides Limited Historical Record

ORAL PRESENTATIONS

PREPARATION

- Know your Audience
  - Interests, biases
  - Who will support you
  - Who will oppose you
  - Who is the decision maker
- Know What You're Trying to Achieve
  - Information briefing
  - Status report
  - Appeal for action
- Find Out How Much Time You Have - 1/2 hour, etc.
- You Must Always be in Command

- Provide a Frame of Reference
  - Make Certain They and You Have Understanding of Situation
    - Purpose
    - Setting
    - Constraints
- Practice or Dry Run
- State Purpose, Identify Key Conclusions
  - Identify Key Benefits
  - Support your Arguments
  - Make Clear Recommendations
  - Anticipate Problems & How to Carry Out Recommendations

- Use Visual Aids
- Avoid Unnecessary Comments & Detail
- Recognize Contribution of Others
- Don't Get into Arguments
- Remember YOU'RE SELLING YOUR REVIEW

SELLING RECOMMENDATIONS

- IDEAS SHOULD USUALLY BE SOLD IN THE ORDER OF THEIR ACCEPTABILITY
- SOMETIMES AN IDEA IS MORE READILY ACCEPTED WHEN PRESENTED WITH POSSIBLE ALTERNATIVES
- SELL DURING THE REVIEW. SELLING IDEAS PIECEMEAL INSTEAD OF A FORMIDABLE LIST AT END OF REVIEW
- TIMING EXTREMELY IMPORTANT
- IF IT CANNOT BE INSTALLED IMMEDIATELY, ADVISABLE TO INCLUDE A PROPOSED TIMETABLE FOR INSTALLATION
- SELL RECOMMENDATIONS TO MANAGEMENT. SELLING RECOMMENDATIONS TO RANK AND FILE IS THE JOB OF LINE MANAGEMENT. HOWEVER - OFFER TO ASSIST
- RECOGNIZE THAT RELUCTANCE TO CHANGE IS PART OF HUMAN NATURE

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B. Preparation of Study Plan.

The study plan serves as a documented agreement between the Division Administrator and the review team. It gives the review team the authority to review the State's operations. It also outlines the steps to be taken during the review.

1. Purpose -

See I. A. 1.

2. Background -

A history of the events leading to initiation of study.

3. Scope -

See I. A. 3.

4. Study Objectives -

See I. A. 2.

5. Study Responsibilities -

Members of study team, as well as special support activities required of other offices or personnel.

6. Approach -

Describe the sequence of major activities to be undertaken and methodologies to be employed during planned phases of study (from preliminary analysis through report preparation).

7. Review Schedule -

Time table for the conduct of the phases and expected completion date.

II. Preliminary Analysis (Preliminary Review Phase)

The purpose of the preliminary review phase is to educate the reviewer in the area of study and identify data already available and data which must be collected during study.

A. Areas of Review -

1. Mission and function.

2. Organization and staffing.

(More)

3. Delegations of authority.

4. Workload (units, standards, backlogs, etc.)

5. Policy and procedure manuals.

6. Layout and flow of work.

7. Forms and reports.

8. Specifications and plans.

9. Technical manuals.

B. Data Collection Checklist -

Information to be obtained prior to interview phase of review.

C. Briefing and Orientation Session -

The purpose is to:

1. Orient the unit's supervisor and employees to the forthcoming study.

2. Verify accuracy of data collected during preliminary analysis phase.

3. Arrange interviews.

4. Distribute questionnaires or survey forms.

III. Data Collection Phase

There are four basic methods of collecting data:

A. Study of Existing Records -

Some of these records were reviewed during the preliminary analysis phase. However, this time you are looking for more details.

B. Interviews -

Serve to verify or correct recorded data and also to collect additional information.

C. Questionnaires -

Used when there is a shortage of time or because of physical location, cannot personnally interview personnel.

(More)

D. Personal Observation -

Examining activities, operations, or employees. Some of the methods are:

1. Desk audits.
2. Job/task analysis.
3. Process tracing.
4. Physical layout.

IV. Analysis Phase.

Analysis is developing an accurate picture of the area under review and comparing it to the ideal situation which should exist. This is primarily a process of measurement, both quantitatively against existing standards and objectives, and qualitatively in terms of desired management results. There are three major stages:

A. Organizing Data -

1. Spread sheets.
2. Table of figures.
3. Interview forms.
4. Organization charts.
5. Process charts.
6. Layout analyses.
7. Informal notes taken during observations.

B. Analyzing Data -

1. Verify discrepancies.
2. Complete omissions.
3. Examination.
4. Arrive at conclusions and tentative recommendations.
5. Test complex recommendations.
6. Discuss conclusions and recommendations with management.

(More)

C. Develop Proposals and Recommendations -

Identify deficiencies or problems and determine appropriate actions to be taken. The goal is to improve the process. Recommendations should be:

1. Constructive in nature.

2. Address a specific problem.

3. Propose specific actions to be taken.

4. Identify who should take action.

5. Are consistent with and supportive of other recommended actions.

6. Are realistic and logically supportable.

7. Include draft implementing documents (i.e., new or revised letters, procedures, delegations, forms, etc.)

V. Documentation Phase

Outline for formal written reports -

A. Introduction -

1. Background.

2. Review objectives.

3. Review approach.

B. Summary of Recommendations (Executive Summary)

C. Detailed Findings, Conclusions, and Recommendations.

1. Findings.

2. Conclusions.

3. Recommendations.

D. Implementation Plan

VI. Implementation and Follow-up Phase

A. Develop an implementation plan and schedule and provide guidance to the State if needed.

B. Perform a follow-up review a few weeks after implementation has been completed. A second follow-up approximately six months later.

PR&E REVIEW PLAN

Process Review of the State Highway Agency's Construction Management System

1. PURPOSE

To announce the initiation of a process review of the State Highway Agency's construction management system to be conducted by representatives of the FHWA Division Office.

2. BACKGROUND

Title 23 requires that the States' processes result in Federal-aid highways which are safe, durable and have economy of maintenance. Process reviews were instituted as a means of providing assurance that these processes are in keeping with the stated requirements.

3. SCOPE

The review team will analyze the processes and procedures of SHA in order to assess and document the construction management that is provided at the various levels of responsibility. The review will include an examination of management's concept of optimum staffing at the project level, and the methods employed to achieve acceptable results.

4. REVIEW OBJECTIVES

a. To ascertain the degree and quality of construction management within ' . State Highway Agency (SHA).

b. To determine if the delegated authority, control and feedback procedures, staffing, organizational structure and level of training for construction management within SHA are adequate to accomplish its stated mission and functions.

5. REVIEW RESPONSIBILITIES

The review will be conducted by _____ and _____ of the FHWA Division Office. Assistance will be provided by _____ as necessary.

6. APPROACH

The study approach will include the following major elements:

a. Preliminary Planning and Analysis. Available documentation such as organizational and procedural manuals, directives, previous reviews, correspondence, and mission/function statements will be reviewed to familiarize the study team with the SHA's operations. Methods for gathering, recording and compiling review data in a useful format will be developed.

b. Data Collection

The review team will conduct interviews in the SHA Headquarters Office, district offices, and with a representative sample of the project offices. This sequence of interviews represents the progression in which policy and management decisions are disseminated. It

provides an opportunity for verification of procedures at each successive level of management during the review.

Additionally, the review will include an examination of records, files, plans, and contracts to verify the management procedures discussed during the interviews; and observations of work in progress and completed, also to verify the application of management processes and procedures discussed during the interviews.

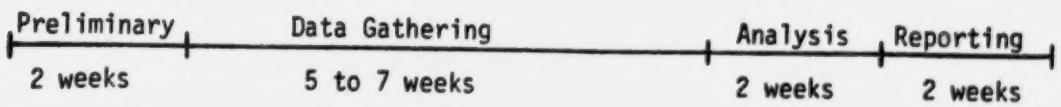
c. Data Analysis and Development of Findings, Conclusions and Recommendations

Verified interview data will be arrayed so that it may be compared with existing criteria and standards for effective and efficient construction management. Particular emphasis will be placed on delegations of authority, control and feedback procedures, adequate staffing and level of training. Any deficiencies found will be highlighted and discussed with individuals assigned program responsibility to determine appropriate corrective measures. These will be presented as recommendations.

d. Preparation of Review Report

A draft report will be provided to responsible individuals for their comments and suggestions prior to finalization and submission to the Division Administrator.

7. REVIEW SCHEDULE



DATA COLLECTION CHECKLIST

Process Review of the

State Highway Agency's

Construction Management System

A. Prior to Interview (If available):

1. Functional and delegated responsibilities of unit to be reviewed.
2. Documented procedures for performing specific functions.
3. Lines of communication and supervision.
4. Are inspection engineering personnel correctly assigned according to their experience and training.
5. Organization of Construction Division.
6. Organization of State Highway Agency.
7. Staffing breakout for Construction Divisions.
8. Workload indicators - trends, numbers of projects, size/complexity/type of projects.
9. Type of reports issued as a result of State and FHWA inspections. Where are reports distributed? Do reports contain recommendations and implementation plan? Is there follow-up? How is it monitored?

Some of these items may be identified during the interview so timing should be flexible for this activity.

B. During Interview:

1. Process involved in performing certain duties - (step by step procedures for major activities) - flow chart?
2. Actual responsibilities of Construction Engineer (and others) - (compare with position description).

   2a. Are responsibilities and authorities sufficient to handle job properly?
3. What documentation is made of inspections?
4. When problems are identified, how are they handled? Is there documentation? and follow-up?
5. What are views of interviewee? Do they supervise too many? Too few? Or is there too much construction supervision? Not enough? Are duties of subordinates equitably and logically divided?
6. Is there overstaffing or understaffing?
7. Is proper and adequate training available to accomplish your job effectively? What additional skills would help accomplish job more effectively?

   7a. Is there anything that impedes accomplishing job effectively?
8. At what level are key inspection elements being reviewed?
9. Roughly, how is time divided among various duties?

10a. How does the Central Office evaluate the District's application of standards re: proper inspection?

10b. How does the project manager evaluate the production output of inspection activities?

11. Are there peaks and valleys in the workload? If so, how might this affect the quality of construction management?

12. Is there an informal organization that functions separate and apart from the formal?

    a. reporting assignments and supervision.

    b. job assignments.

    c. scheduling.

    d. personal relationships

13. What assurances are there that a quality end product is being produced?

A GUIDE FOR ADMINISTERING FEDERAL HIGHWAY ADMINISTRATION MANAGEMENT REVIEW REGARDING MAINTENANCE OF FEDERAL-AID HIGHWAY PROJECTS

INTRODUCTION

The need for and purpose of making maintenance inspections on completed Federal-aid highway projects are set forth in Section 116 of Title 23, USC, which reads in part, as follows:

> It shall be the duty of the State highway department to maintain, or cause to be maintained, any project constructed under the provisions of this chapter or constructed under the provisions of prior Acts. The State's obligation to the United States to maintain any such project shall cease when it no longer constitutes a part of a Federal-aid system.

FHWA policies and procedures for making maintenance inspections are prescribed in FHPM 6-4-3-1.

In carrying out the inspection, the inspecting engineer will use in addition to these instructions, copies of Title 23 and pertinent policies and maintenance guides of the American Association of State Highway and Transportation Officials, FHPM 6-4-3-1, State Maintenance Manuals and any maintenance management manuals.

OBJECTIVE AND APPROACH

The objective of the management review is to evaluate the management potential of the State highway agency, both at the central office and the district levels, to determine: (a) if the State maintenance organization has the necessary management potential to provide proper maintenance; and, (b) whether or not this management potential is being properly applied at the working level; and, (c) whether or not the State's system is resulting in effective and adequate maintenance of the highway facility.

WORKING PAPERS

The main purposes of working papers are (1) to provide a substantiating record of work performed in carrying out an assignment and (2) to provide a record of information and evidence obtained and developed in support of our findings, conclusions and recommendations.

The sources of all information appearing on a working paper should be shown in sufficient detail to permit referral to the source, should the information be challenged at a later date. Ordinarily, each working paper should indicate the purpose for which it was prepared, and contain information in sufficient clarity to permit independent review without oral supplementation by the preparer. Each working paper should be signed and dated by the preparer.

A summary should be prepared for each section of the working papers, showing the work performed, the results achieved, and the conclusions reached.

CONFERENCE PROCEDURES

An initial conference should be held with the State personnel that will be directly connected with the field inspection to explain the objectives and approach.

At the conclusion of the field interviews and inspections, a draft report should be prepared by the Division Office for use at a preliminary close-out conference with FHWA inspection personnel.

The report should be organized in such a manner that responsive comments by appropriate FHWA officials may be added at the end of each finding. Sufficient copies of this draft report should be made to permit each office to retain one copy for its use in taking any action which it may consider appropriate pending receipt of copies of the final report.

After all parties concerned in FHWA are in agreement with the information contained in the initial draft report, the final draft report should be prepared by the FHWA Division Office. A closeout conference with appropriate State design, construction, maintenance and top-level administrative personnel, together with FHWA engineers, should be arranged to discuss findings and recommendations.

A final report shall be prepared after the FHWA and State are in agreement with the findings and recommendations. Copies of the final report shall be submitted to the Region and Washington Office for their ready reference.

EVALUATION OF MAINTENANCE POTENTIAL

The following outline may be used as a guide to determine the potential for maintaining Federal-aid improvements:

I. State Central Office Supervision of Maintenance Activities

A. Objective

Evaluation of the extent and effectiveness of central office surveillance of the district maintenance program, and of maintenance by counties and other local governments.

B. Steps

I. Central office personnel and other appropriate means determine:

a. The frequency of field visits by central office personnel, the purpose and effectiveness of such field visits, and the extent of their participation in the management program.

b. The relevance of any available reports on supervisory inspections conducted by central office personnel.

c. The personnel policies and practices pertaining to position descriptions, salary and wage scales, fringe benefits, job secruity, basis of selection, and promotion.

d. The extent of training, technical supervision, and written instructions provided by the central office, particularly with respect to enhancing maintenance operations.

e. The authority and control by the central office over the organization related to economy and efficiency toward policy administration, direction, supervision, and technical guidance.

f. The adequacy of central office actions to encourage necessary or desirable improvements in procedures and practices pertaining to maintenance operations and the use of improved materials and management practices.

g. The form of analysis and comparison of income and needs concerning adequacy of financing.

h. The basis for preparation of maintenance budget.

i. The policy of the central office to evaluate the maintenance budget for the coming year and the distribution basis of State-allotted revenue.

j. The policy of the central office to determine the feasibility or reliability of the future improvement items.

k. The degree and method of liaison between maintenance engineers, design engineers, safety engineers, and construction engineers, leading to the design and construction of new highway facilities based on the observed service behavior and safety of existing road sections.

l. The provision of adequate records of overall maintenance performance and conditions to permit a competent appraisal of current maintenance practices of appropriate jurisdictions within the State.

m. The policy pertaining to workload, labor force, equipment, equipment use, contract maintenance, procurement and warehousing as concerns the State or local operations.

n. The extent of encouragement to submit suggestions that would improve efficiency in carrying on field office accounting and physical work.

o. The amount and type of interoffice awareness pertaining to cost reduction and quality improvement methods for maintenance work.

p. The plan the State has for placing maintenance activities in a priority system when budget restrictions dictate a management decision.

q. The effectiveness of preventive maintenance in minimizing need for resurfacing, reconstruction, and rehabilitation.

II. State District Office Procedures and Controls

A. Objective

Evaluation of selected district office organizations, controls and procedures to insure that efficient, effective, and safe maintenance measures are employed, including relationship of the district with local governments.

B. Steps

1. Discuss with the district personnel the policy with respect to selection of work and phases of maintenance to be performed, and their relative priority. Inquire as to whether:

a. The district maintenance engineer makes the selections of work on a long-range plan schedule or a day-to-day basis.

b. The maintenance foreman is involved in the planning of workload.

c. Budget appropriation is a major factor in determining work performed, personnel employed, and equipment utilized.

d. Field review of work in progress, completed work, and future anticipated work is undertaken by district representatives.

e. New materials and equipment are utilized by field personnel.

f. The training and encouragement are afforded field people to improve their present positions. (Chapter VI, MUTCD).

g. Problems are resolved through experience, research, or central office advice.

h. District office personnel visit the city or county agencies, advise and inspect.

i. The reporting of maintenance conditions that can be corrected by change in design is performed.

j. The records of costs involved for overall maintenance performance on various phases of operations are reliable.

k. The development of new production techniques, improvements in equipment management, the extension of mechanization and better organization of work, make up in part for any reductions in employment.

l. Appropriate inspection and testing are afforded to contract and State forces maintenance work.

m. The proposed maintenance budget submitted by the district is prepared from past expenditures or calculated anticipated workload based on realistic data obtained from field observations.

III. Review of County or Local Agencies' Procedures and Controls

A. Objective

Evaluation of the county or local agencies regarding their maintenance policies, problems, funds, organization and practices.

B. Steps

1. Discuss with the county or local agency responsible for maintenance, the operations and responsibilities connected with their work. Inquire as to whether: (Same general questions included under State Central and District Office Procedures.)

IV. Field Review of Maintenance Activities

A. Objective

Evaluation of the field control and procedures to accomplish the activity and determine workmanship and quality for end result.

B. Steps

1. Visit an active maintenance project where a maintenance operation is being performed and using the State maintenance and/or maintenance management manual as a guide determine the:
   a. Need (Level of Service or Quality Standard)
   b. Planning & Scheduling (Quantity Standard)
   c. Labor, Equipment and Materials (Productivity Standards)
   d. Traffic Control (Work Area Safety)
   e. End Result (Workmanship and Quality)

V. Measurements of the Conditions of the Various Elements

A. Objective

To evaluate in detail the maintenance work done and the work necessary as compared to the work planned and scheduled on a random section approximately 10 miles in length having a reasonably uniform traffic volume throughout its length, the same general type of standard, and generally established with easily identifiable termini. In carrying out these inspections a minimum of four sections should be selected in each State district included in the process review. These sections should represent the Interstate, Primary Urban and Secondary systems.

The sections reviewed should include all interchanges, structures, and approaches that have been completed as part of the Federal-aid construction.

Depending upon the maintenance setup within a State, the sections selected should include the different governmental agencies directly responsible for the maintenance of Federal-aid projects.

The following should be reviewed:

1. Routine and Special Roadway Surface Operations

   The condition of the roadway surface should be recorded with special emphasis given to preventative maintenance work that has been completed or needs to be performed. The quality of maintenance is a considerable factor in preserving the

lifetime of a pavement surface and its serviceability during that period. Quality of maintenance is based upon a combination of the right materials and their proper and timely use.

Pavement characteristics should be identified which indicate deterioration of the physical integrity or a reduction in the operational characteristics of the highway. Surface deterioration, slipperiness, stripes and marking condition, obstructions and snow and ice control results are some items for condition recording.

2. Shoulders and Side Approaches

The general types of shoulders such as earth or sod, gravel or crushed rock, oiled or paved, private and public approaches, turnouts and turnarounds should be reviewed with emphasis on surface condition, dropoff and obstructions.

3. Roadsides

Generally the roadsides are the areas between the outside edges of the shoulders and rights-of-way bounderies. For review purposes the unpaved median areas, interchanges, rest areas, historical sites, and view points are included in this category.

Conditions should be recorded on the vegetation management programs, vegetation control, landscaping, rest areas, litter and erosion. Roadsides should be maintained as nearly as practical in a condition that supports safety, appearances, convenience, and pleasure of the public and the preservation and protection of the roadway.

4. Drainage

Highways are designed with drainage systems to keep water from damaging the structure by controlling or directing the free flow of water over, under, or adjacent to the roadway. Condition observations should be made of the process of keeping courses free from accumulations of dirt, debris, vegetation, and other obstructions. Correcting half-functioning parts of systems are also maintenance functions.

5. Bridges

The condition of the substructure and superstructure should be evaluated with special attention directed toward comparison with the State inspection report.

6. Traffic Services - Snow and Ice Control

The general policy of the State to implement removal operations and the means to carry out the plan should

PROCESS REVIEW GUIDE

I. PROCESS REVIEW GUIDE

A. Purpose: the purpose of this guide is to:

1. Standardize the review format.
2. Ensure a quality end product.
3. Guide the reviewer through the preparation of his process review guidelines.
4. Inform the reviewer of initial parameters of a good process review.

B. Scope:

The instructions are intended to provide the basic steps of a process review and each reviewer is expected to develop the necessary detail to complete each step. The instructions include direction on:

1. How to describe the intended process and the process actually being used.
2. How to determine the effectiveness of the process.
3. How to prepare the recommendations.
4. How to take appropriate action.

C. Instructions:

1. Describe the intended process - there are numerous sources of information and knowledge which can aid reviewer in gaining an understanding of the intended process. This information is a result of the planning function, in a management sense.

(a) Sources

Organization Charts
Policies
Procedures
Specifications
Administrative Manual Programs
Standard Operating Procedures
Standards
Plans
Organization Goal and Objectives
Technical Manuals

(b) The intended process should be indentified and described in such detail as to accurately identify how the organization is designed to function. In doing so:

- Prepare an activity flow diagram of the intended process.
- Prepare a brief narrative description of the process.
- Define the levels of responsibility for each activity.
- Identify the existing control mechanisms and (milestones).
- Describe the intended end product and desired quality characteristics.

2. To identify to what extent the intended process is being followed:

(a) Prepare an activity flow of the actual process.

(b) Prepare a brief narrative description of the actual process verified by a step-by-step review of the activity sequence through personal contact with groups and persons responsible.

(c) Determine the levels of responsibilities through verification of activity links and cohesiveness among the management levels.

(d) Verify that the existing mechanisms and critical points of the intended process are occuring. For example if a State's intended process includes, say, a prefinal design meeting prior to further development, the reviewer should verify that the meeting occurs.

(e) Verify activity accomplishments through review of the product. The reviewer must be satisfied that the samples reviewed are representative of the process.

3. Determine the effectiveness of the process being used.

(a) Several characterisitics have been identified as being common to any effective process. The reviewer shall determine if these characteristics are being met by answering the following questions:

- Is there a clear sense of direction and purpose?
- Are alternative courses of action being developed and considered?
- Are the necessary tools available for management of plans, schedules, control resource expenditures, work flow, and product quantity?
- Are various management units linked in a cohesive manner to provide the timely exchange of pertinent information?

(b) Determine the effectiveness of the process by examination of the product. Consider the following:

- Identify the critical stages and control points of the process and develop a priority listing.
- The reviewer shall inspect the product at the critical control points.
- The reviewer shall assure himself, by applying quality assurance techniques (when applicable), of an adequate sampling of the process products.

- Those elements most important to the quality of the end product shall be determined, prioritized, and examined at each stage previously determined.

- The reviewer shall determine the conformance of the product to acceptalbe standards by observation and interpretation of regular insepction and process control.

- Findings shall be documented to reflect process control (or non control) and to take corrective action to remedy the immediate product deficiencies.

4. Taking appropriate action.

   In determining appropriate actions and making recommendations it should be kept in mind that the goal is to improve the process. Identification of deficiencies or problems is only one step in attaining process improvements. Overemphasis on deficiencies accomplishes little. Guidance concerning potentials for positive action is more successful.

   (a) Identify the deficiencies.

   (b) Make recommendations toremedy the situation.

   (c) When making any recommendations always tie it to the review findings.

   (d) Recommendations should be solutions to problems and not only identification of symptoms.

   (e) The Divisions Annual Work Program reevaluate those process items determined to be deficient in order to determine if the recommendations were implemented and if so was the recommended action successful.

II. This outline is presented to assist the report writer in presentation of the process review results in a concise, standardized format.